

Issue
11-1-21

THE SENDER

It became evident at an early stage of development that, considering the basic necessity of having a large number of trunks in one group so that economy in both inside equipment and outside plant might be affected, the system could not be laid out on a 10 or decimal basis. At the same time it was obviously desirable that the calling devices which were to be manipulated by operators or subscribers be arranged on a decimal basis.

Another important requirement brought about by the large trunk groups was that with the switches or elevators under direct control of the calling device there was not a sufficient interval of time between the sending of one set of impulses and the next to permit the switches to hunt and find an idle path or trunk after it had arrived at the bottom of a large group. This hunting operation, it might be explained, is the search which each elevator or switch must make for an idle or non-busy path in a certain direction, it being evident that a number of parallel paths must be provided to a certain office or to a particular group of lines in an office, so that more than one subscriber can call in that direction at a time.

These conditions, among others, led to the development of the register or "sender," which is an electrical circuit that receives and stores the impulses as they are sent in from the calling device on a decimal basis and then controls the elevators or selectors in their upward motion toward the terminals of the trunk group or line wanted in such a way as to cause them to arrive at the proper point no matter where the terminals may have been placed on the selector banks.

When the elevators are started upward the senders permit them to go to the desired point and then stop them by removing their driving power. This is accomplished by having the elevators slide over vertical commutators and transmit back to the sender the number of impulses which it (the sender) has been set to receive by the manipulation of the calling device at an operator's position or a subscriber's station.

The use of senders results in many advantages, among them the following:—

1. It permits the system to be worked out on a non-decimal basis, which is necessary in arriving at the most economical grouping of trunks. This is accomplished by having the sender receive a series of impulses on a decimal basis from an operator or a subscriber and translate them to any desired non-decimal basis.
2. It permits the elevators or switches to hunt over any number of trunks in a group without any reference to the speed with which the impulses from a calling device are sent in, i.e., the operation of the switching apparatus is rendered entirely independent of the speed of the calling device.
3. The removal of the control from the subscriber's or operator's calling device opened the way for building robust and rugged power driven switches that could be operated at their best speeds and controlled by circuits local to the office.
4. In the engineering of a machine switching system serving cities like New York, Chicago, and other large centers, it is practically indispensable, since it permits of arranging the trunk groups outgoing from any office in any way that may be most economical; it allows trunk groups to be made larger or smaller or shifted from one part of the multiple to another, in case conditions change so as to make any of these procedures necessary.

This results in economy in the first cost of apparatus and avoids the danger of having the chance for growth on any group of trunks so blocked as to render future expansion expensive and difficult. This is clearer when we consider that a call for a certain station system must always be dialed the same, i.e., the same digits must be set up or pulled exactly as they are listed in the directory, and if the switches were directly controlled this would mean that a group of trunks outgoing in a certain direction, would always have to appear at a certain point on the banks.

It frequently occurs that there is a need for 100 outgoing paths or trunks from office "A" to office "B", but only 10 paths are needed from office "C" to office "B". If the terminals of the outgoing paths or trunks in both office "A" and office "C" had to be arranged in the same relative position on the selector banks, considerable extra expense would be involved in certain offices where the arrangement possible did not lend itself to the requirements.

Through the use of the "Sender" the first digits of the number which indicates office "B" will be received at office "A" and be so translated that the selectors in that office will be properly stopped at the bottom of the group of trunks outgoing to office "B", whereas in office "C" the senders will receive the same digits indicating office "B", but will translate them in such a manner as to cause the selectors under their control to stop at an entirely different place. Thus, the sender makes the system flexible and less costly in that the most economical layout can be used without fear that future expansion in any direction will be blocked. Without the sender, solution of the complex problem involved in large centers would be much more difficult and expensive, if not impossible.

The flexibility of the sender permits arranging a numbering scheme of subscribers' lines so that the gradual change from manual to full mechanical in multi-office cities can be accomplished without the great confusion which would otherwise result.

There are several different kinds of senders, each designed to handle a specific portion of the various kinds of traffic. The most important kinds of senders are as follows:

- 3 digit subscriber's or "A" senders,
- 2 digit subscriber's or "A" senders,
- "B" operator's, cordless, or "B" senders,
- Suburban or special operator's senders,
- Local, or distant district senders,
- Desk senders,
- Key indicator senders,
- Incoming senders.

The subscriber signals by means of dial impulses directly into the "A" sender, which must function to register or record the number signalled. Before the signalling has been completed, the sender has already started the switching mechanism, picking the proper path necessary to extend the call, link by link, to the line of the party called.

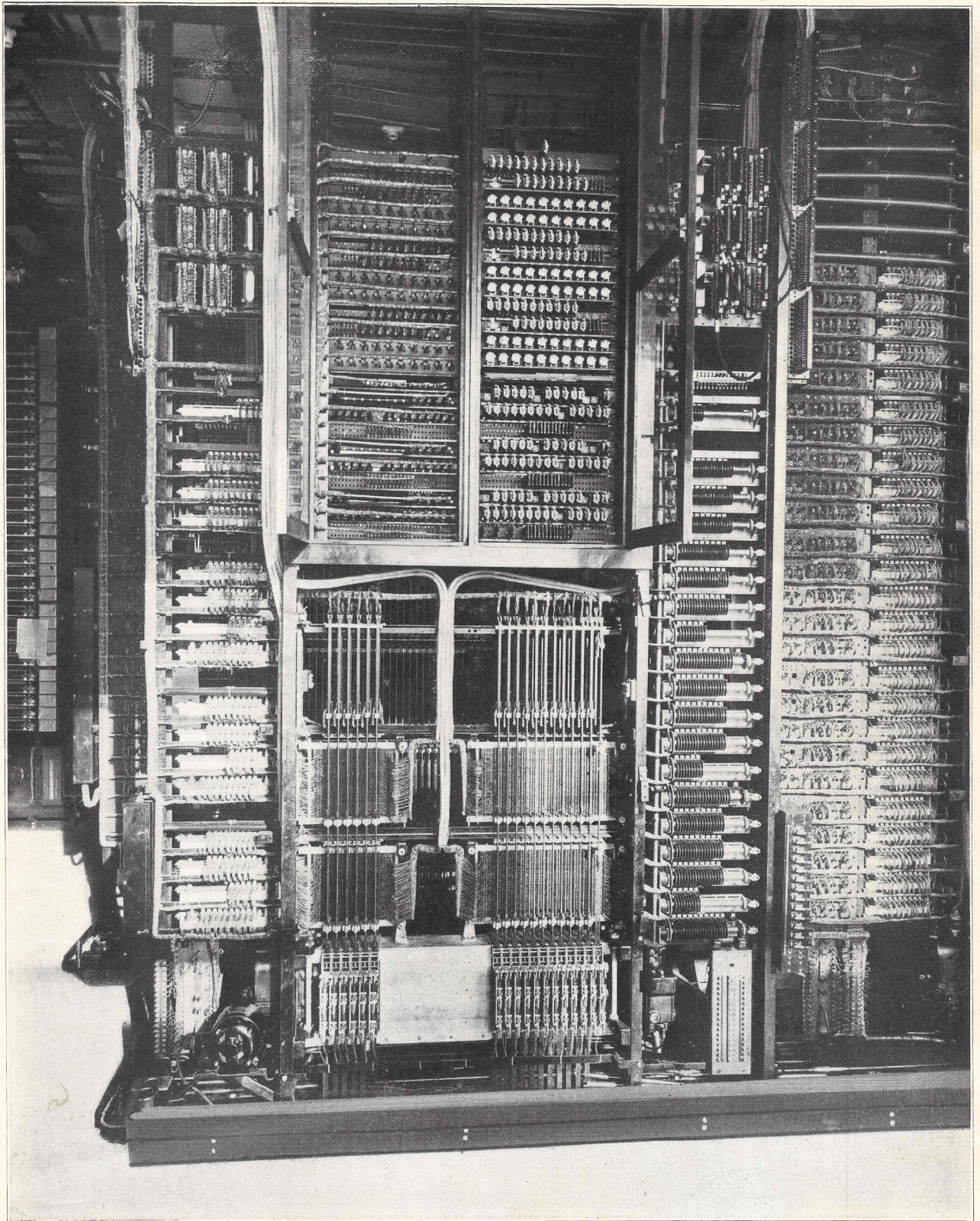


FIGURE 7.1013

The "B" or cordless operator's Sender, Sender Selector and Trunk Finder frame.

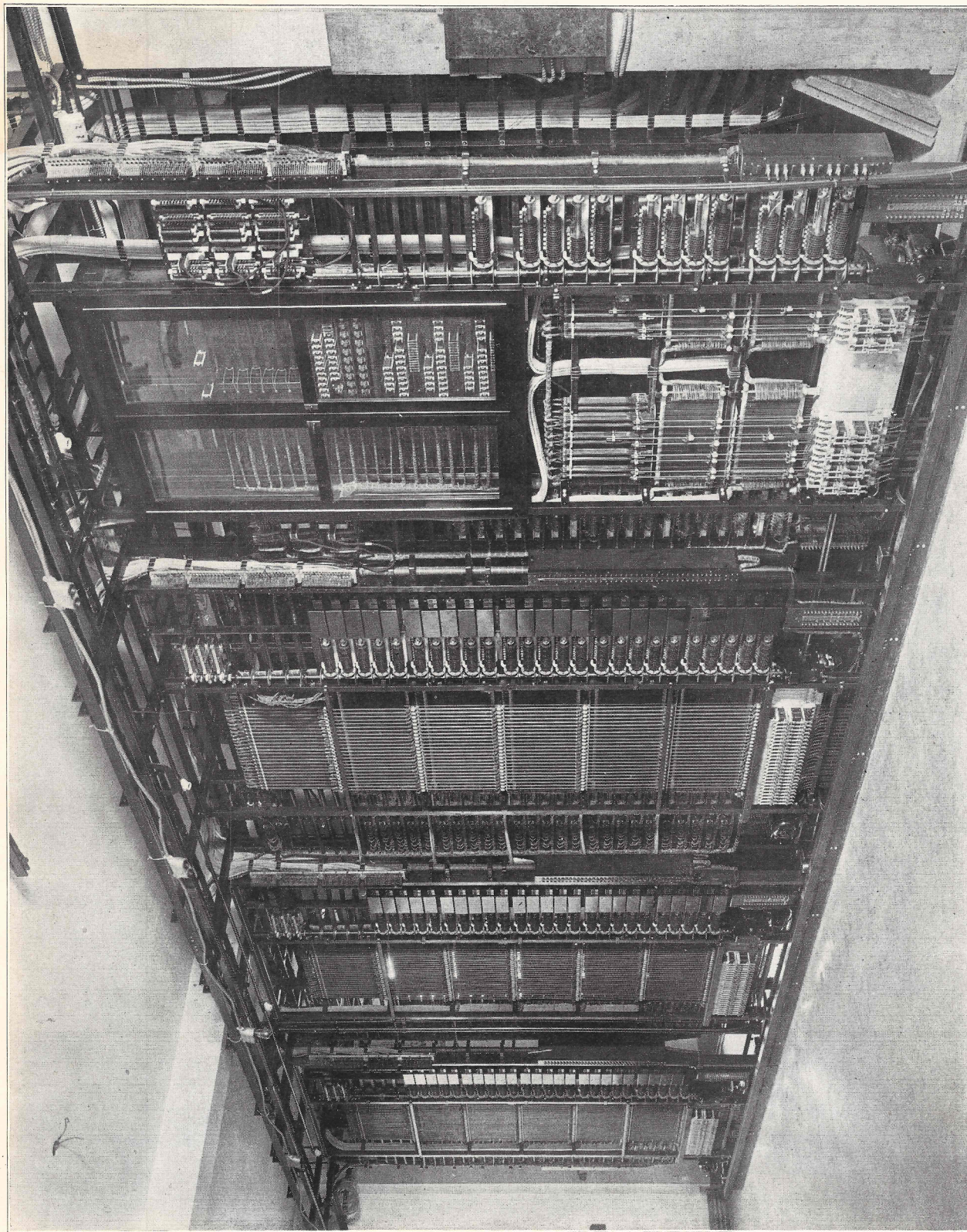


FIGURE 7.1014
Line-up of incoming selector frames and "B" sender frame.

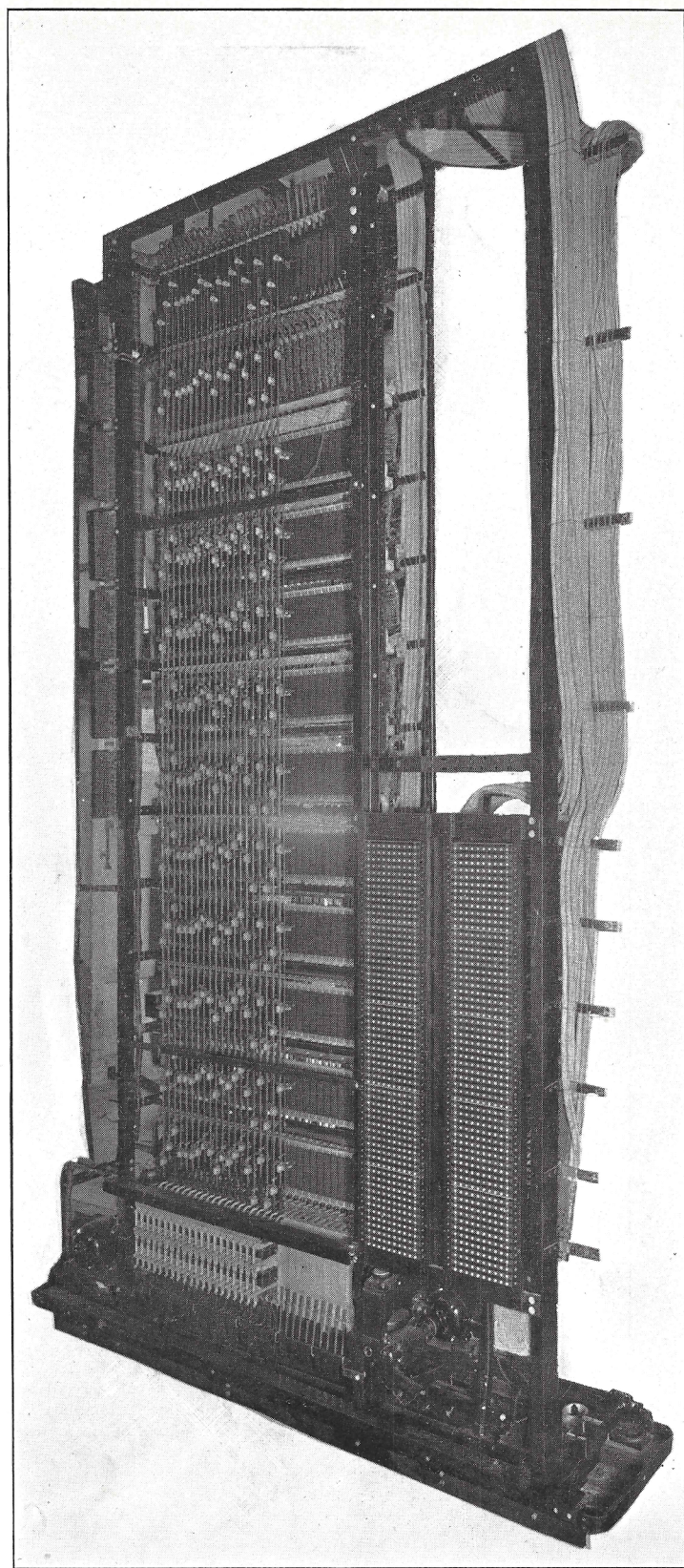


FIGURE 7.1017

The translator frame, used with 3 digit "A" senders.

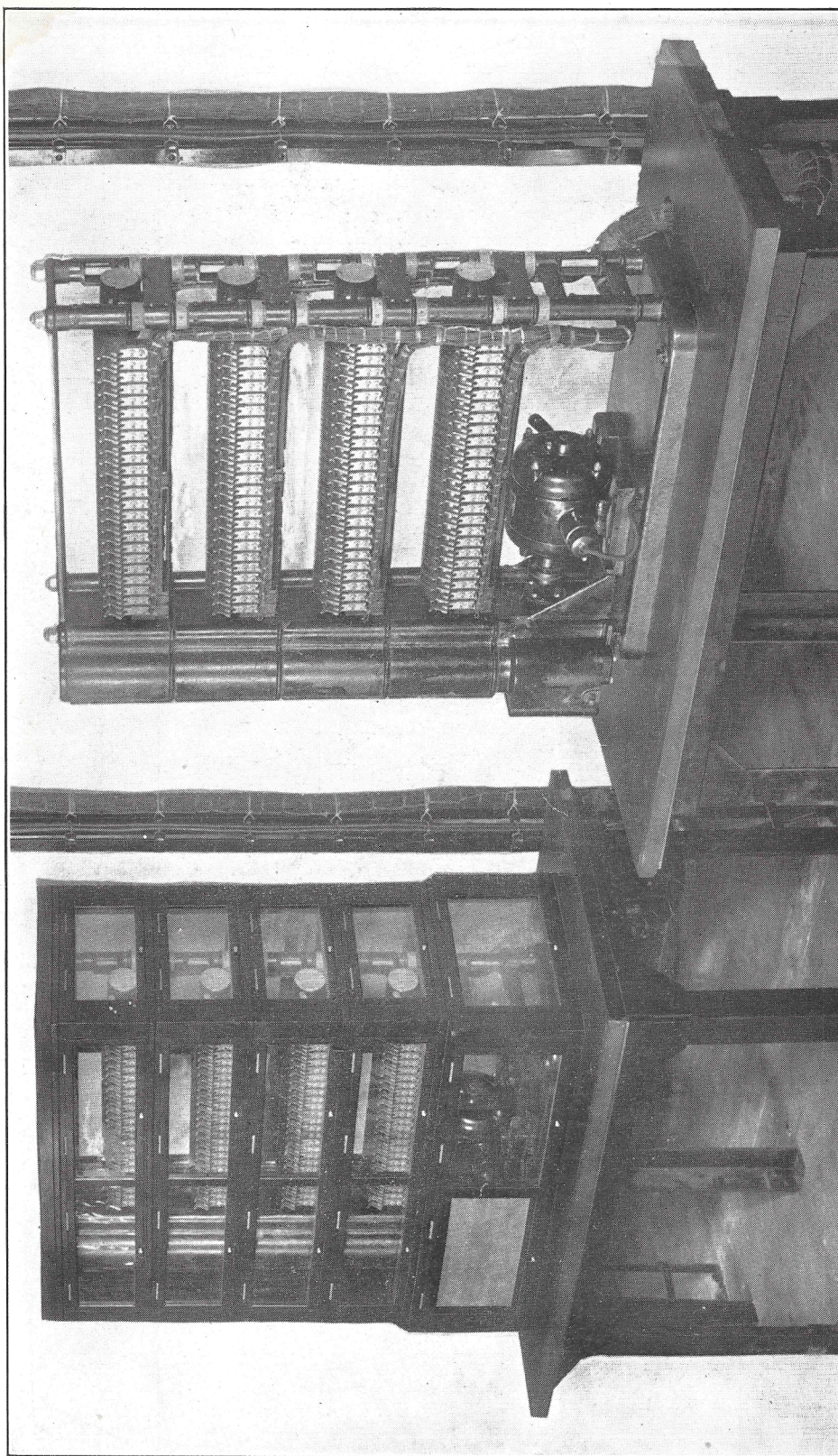


FIGURE 7.1018
Pulse machines, used with 3 digit "A" senders.

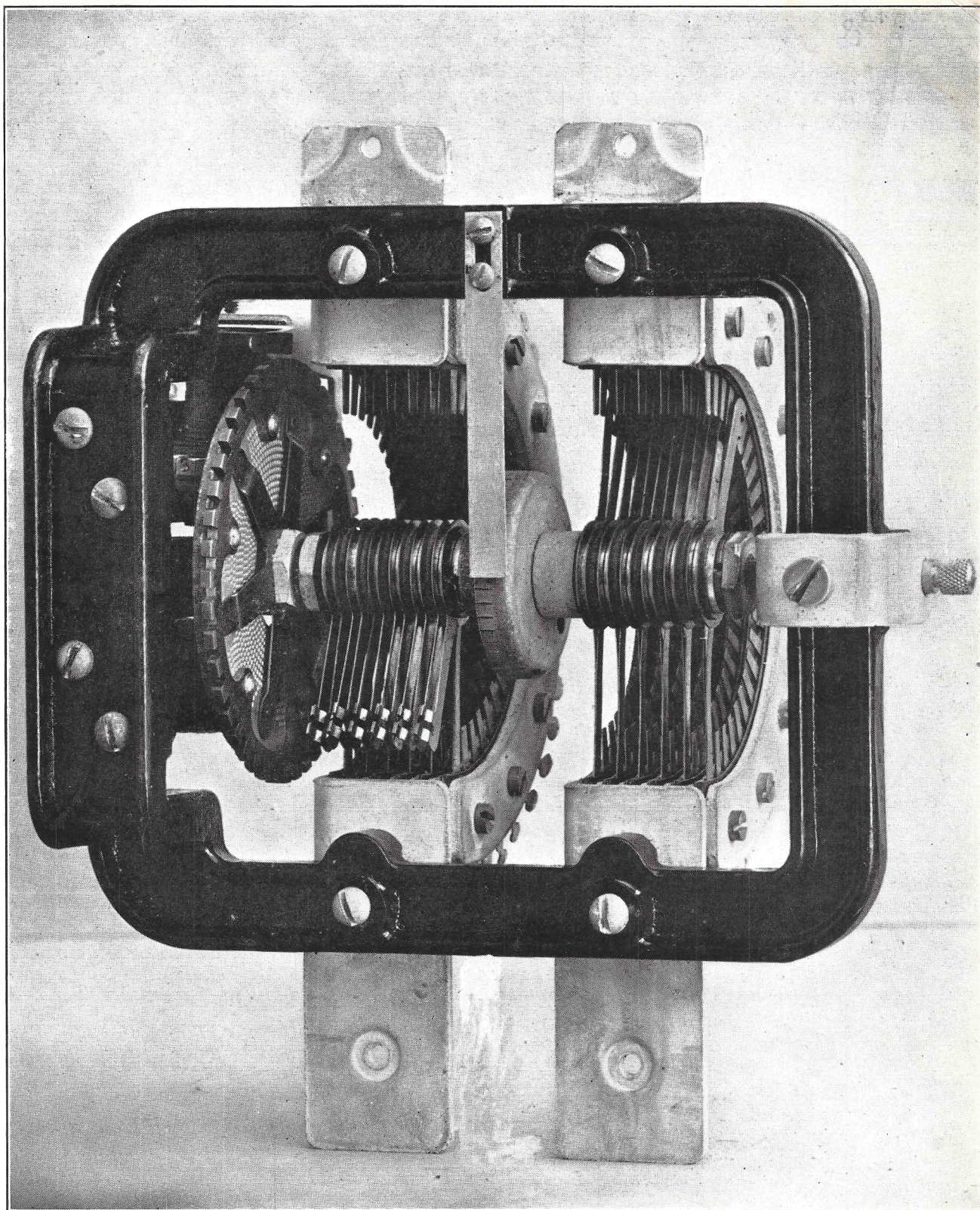


FIGURE 7.1019
The rotary type translator as used on 2 "A" digit senders.

A Two Digit Subscriber's Sender Frame is shown on Figure 7.1011 and a Three Digit Subscriber's Sender Frame is shown on Figure 7.1012. Figure 7.1013 shows a "B" or Cordless Sender Frame and Figure 7.1014 shows this "B" Sender Frame in a typical line-up of Selector Frames as installed in an Operating Company's Central Office.

The Two Digit "A" Sender Frame shown on Figure 7.1011 is the sender frame installed in cities such as Omaha, Kansas City, etc., and consists of ten complete sender circuits, mounted on an iron framework. The center bay is used for mounting the stepping switches, the right hand bay for mounting relays (enclosed in glass) and the left hand bay for mounting sequence switches, interrupters and translators.

The translator as used on this Two Digit "A" Sender Frame, consists of an iron frame work on which are mounted two semi-circular multiple banks arranged as shown on Figure 7.1019. In front of these banks is mounted a shaft driven by an electro-magnetic clutch and on which is mounted two sets of "wipers" or "brushes" mounted at an angle of 180 degrees so that one set of brushes is constantly in contact with a bank. Each bank having 22 sets of terminals, the translator may be set for any one of 44 different positions.

The Three Digit "A" Sender Frame as shown on Figure 7.1012 is installed in cities such as New York, Chicago, Philadelphia, etc., and consists of five sender circuits mounted on an iron framework. The left hand bay of the frame is used for mounting sequence switches, interrupters and resistances. The center and right hand bays are used for mounting the stepping switches and relays. The relays are mounted in the lower portion of the bays and are enclosed in glass. The Three Digit "A" Sender requires the use of a Translator Frame as shown on Figure 7.1017 and a Pulse Machine as shown on Figure 7.1018.

Each sender is provided with one of the elevators mounted on a translator frame, making use of this elevator and with it, a multiple bank with its cross connections to the Pulse Machine, to accomplish the following:

Arrange to trip one of five District Brushes; arrange to select one of nine District groups; arrange to trip one of five Office Brushes; arrange to select one of nine Office Groups; set the Class Switch; and adjust the Compensating Resistance; all of which are determined by the first three digits dialed by the subscriber.

The translator frame proper consists of ten multiple banks of 40 three wire circuits each, over which move sixty elevators. Over the ten multiple banks, a bank is mounted which is known as the "Hunting Bank", consisting of 57 individual terminals connected independently. One of these hunting banks is required for each elevator, there being 60 all told. The brushes on the elevators are tripped in pairs, thereby connecting six leads from the translator multiple bank to the sender register relays. With this type of translator, it is possible to obtain 200 different settings.

The Pulse Machine is a motor-driven commutator of four drums, to the supply brushes of which battery and ground are supplied. These supply brushes are mounted on one side of the drum, the opposite side mounting the receiving brushes, which in turn are wired to the multiple banks of the translator. The wiring between the pulse drum and translator banks is completed through a Distributing Frame, so arranged as to provide maximum flexibility of connections. The sole purpose of the pulse machine is to supply

the terminals of the translator multiple bank with pulses consisting of interrupted battery and ground, and to provide a timing feature for use in collecting the pulses from the multiple banks.

The "B" Sender Frame as shown on Figure 7.1013 consists of 6 senders mounted on an iron framework, the lower portion of which is used to mount Sender Selector, Allotter, and Trunk Finder circuits. The sender proper consists of a number of relays enclosed in glass.

Other senders are provided to care for traffic handled by special "A" operators; traffic incoming from distant "A" operator's Senders; traffic handled by Central Office Attendants such as Wire Chief, Complaint Clerk, Test Desk Operator, etc.; traffic to Machine Switching Offices of the step-by-step type; traffic from Machine Switching Offices of the step-by-step type; and sometimes senders are provided in manual offices to handle traffic ordinarily handled by the cordless "B" operators.

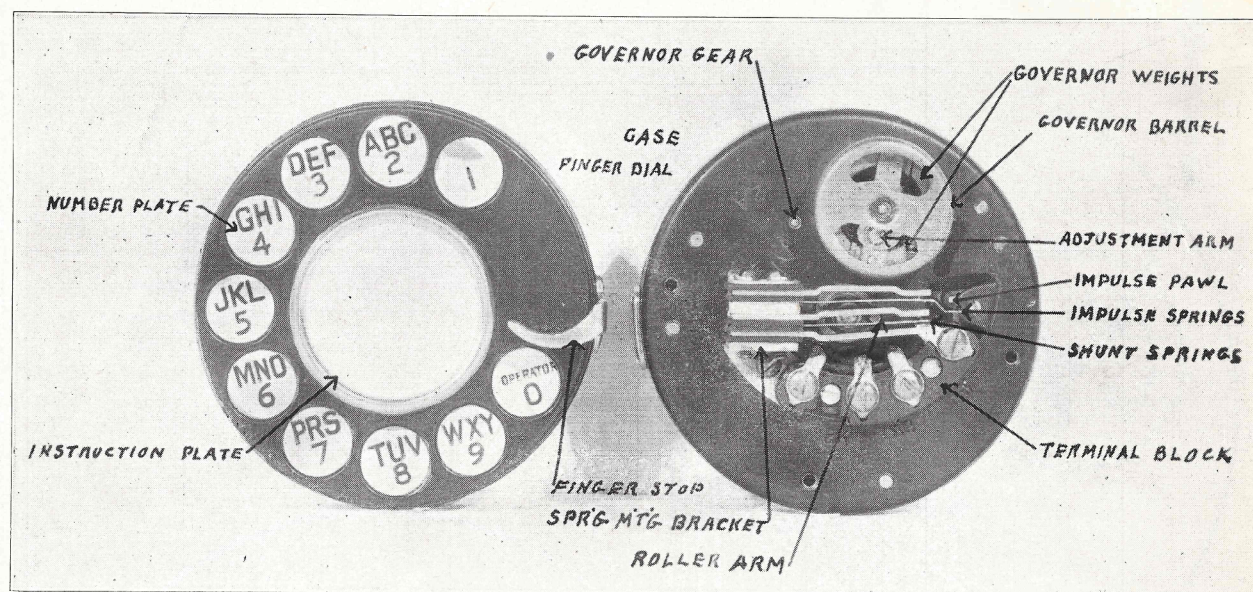


FIGURE 7.1021
The subscriber's dial.

The subscriber's dial is mounted on the telephone set in a convenient location and consists mainly of a set of switches operated by the subscriber in accordance with the movement of a number dial.

The moving portion of the dial, which, in revolving, actuates the switches, consists of a finger dial, number plate, governor, driving gear and an impulse wheel mounted on the main shaft. The dial is rotated in a clockwise direction by the subscriber, and during its return to normal the impulse switch contacts are opened by the impulse wheel. When the dial is released after dialing a digit, it is driven back to normal position by the motor spring. The speed of this return, and consequently the rate of interruption of the circuit, is regulated by a governor mounted on the back of the dial. The successive interruptions of the circuit constitute a number of pulses, which operate a relay in the central office and records or "registers" in the sender circuit.

In order that the pulses be uninfluenced by the varying resistance of the transmitter, a pair of shunt springs are provided. These shunt springs are so mounted and connected that when the dial is moved out of normal position the transmitter is cut out of the circuit, the impulse springs being bridged directly across the tip and ring.

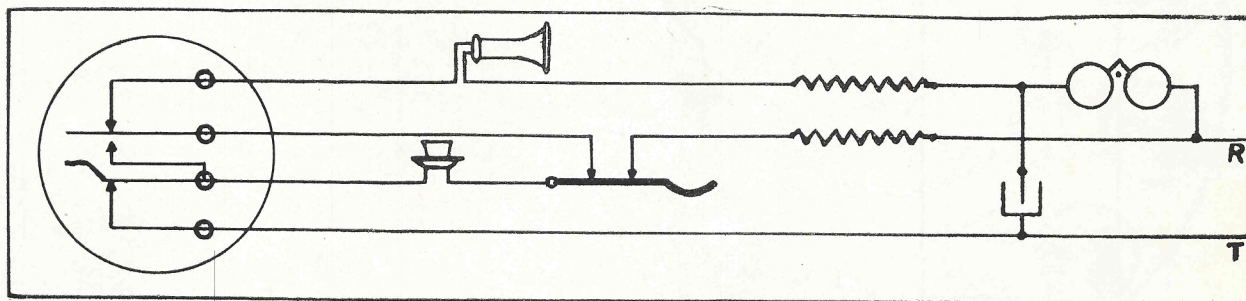


FIGURE 7.1022
The subscriber's set circuit.

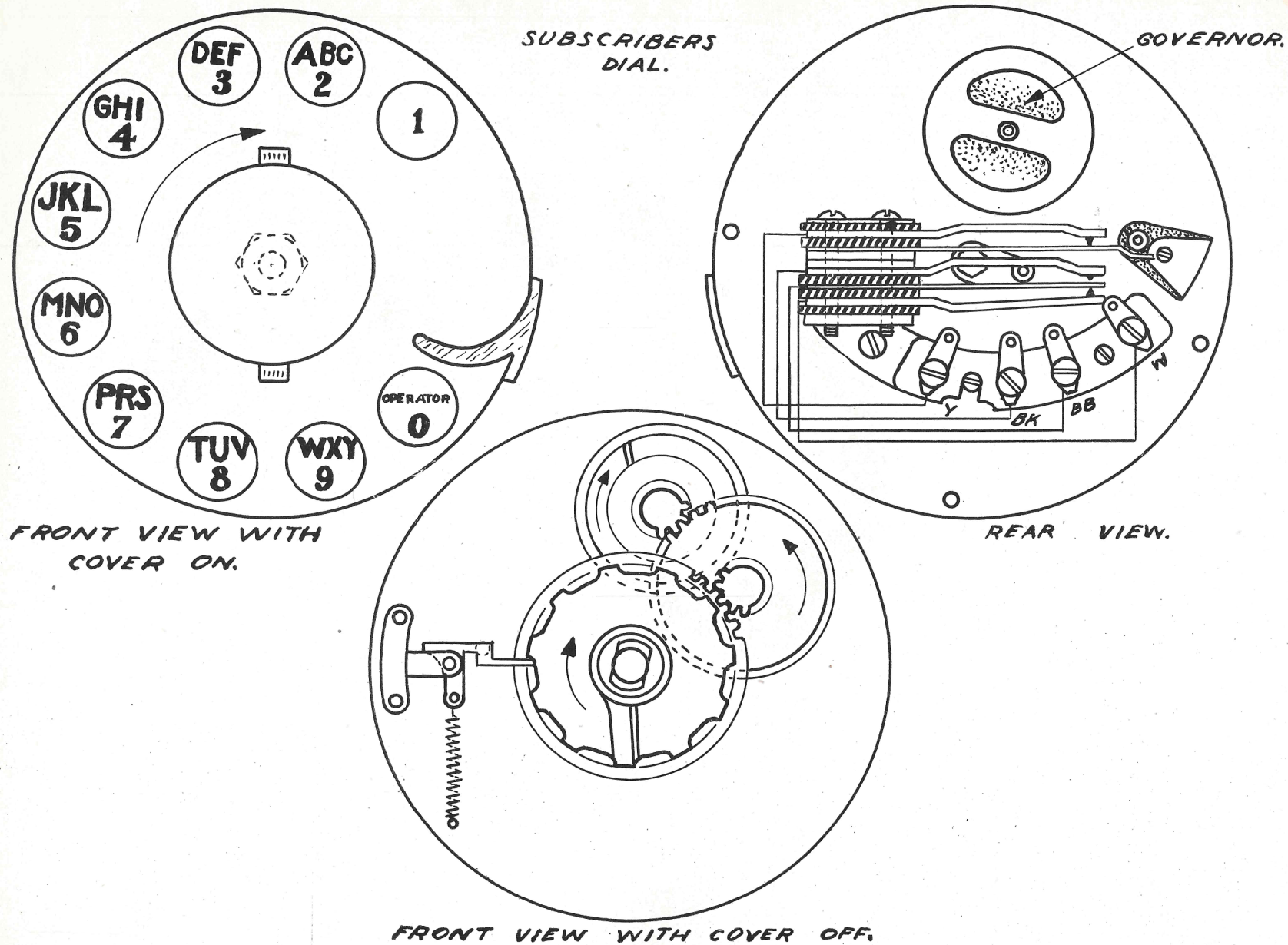


FIGURE 7.1023
Details of the dial.

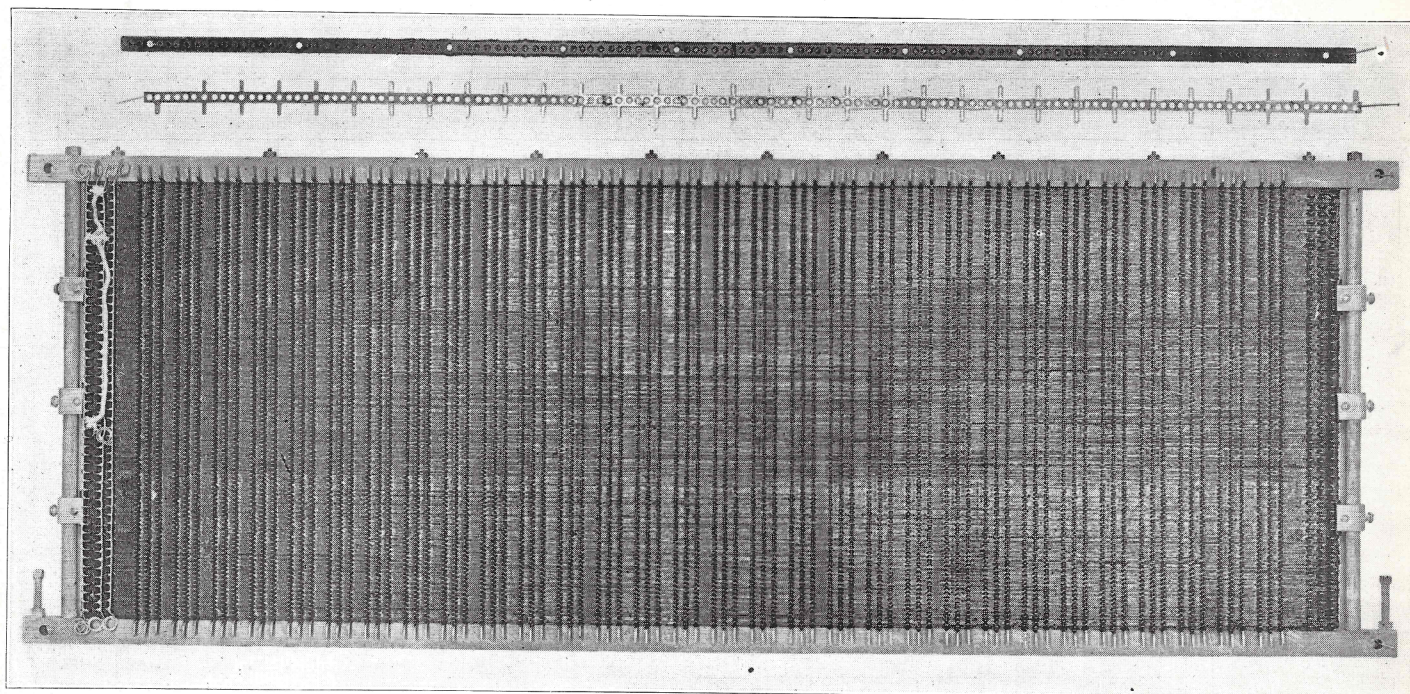


FIGURE 7.1031

The Multiple Bank, sleeve terminal, and insulator.

Each selector multiple bank consists of 300 superimposed brass strips insulated from each other by strips of impregnated paper, the whole being mounted within an iron frame. Each brass strip has sixty projecting lugs or terminals, thirty on each side of the bank. There are three kinds of terminal strips, the Tip, Ring, and Sleeve, so grouped as to form 100 three wire circuits in each bank.

A soldering lug is provided at the two ends of each strip, so that wires may be connected at either end. Exclusive of these soldering lugs, the terminals of the bank form thirty vertical sets or rows of contacts on each side of the bank, each row being provided at the top and bottom with combs or guides to prevent snagging of brushes when moving up and down over the bank.

Illustration 7.1031 shows a multiple bank, a terminal strip, and an insulating strip. Illustrations 7.1032 and 7.1033 show the construction of a multiple bank in detail, and illustration 7.1034 shows five banks as mounted in a typical selector frame.

It is sometimes necessary to provide multiple banks of half the normal width, that is, banks to accommodate 30 selectors instead of 60. This is accomplished by cutting the brass terminal strips in the middle of the bank without changing any of the bank's dimensions. Such a bank is known as a split bank.

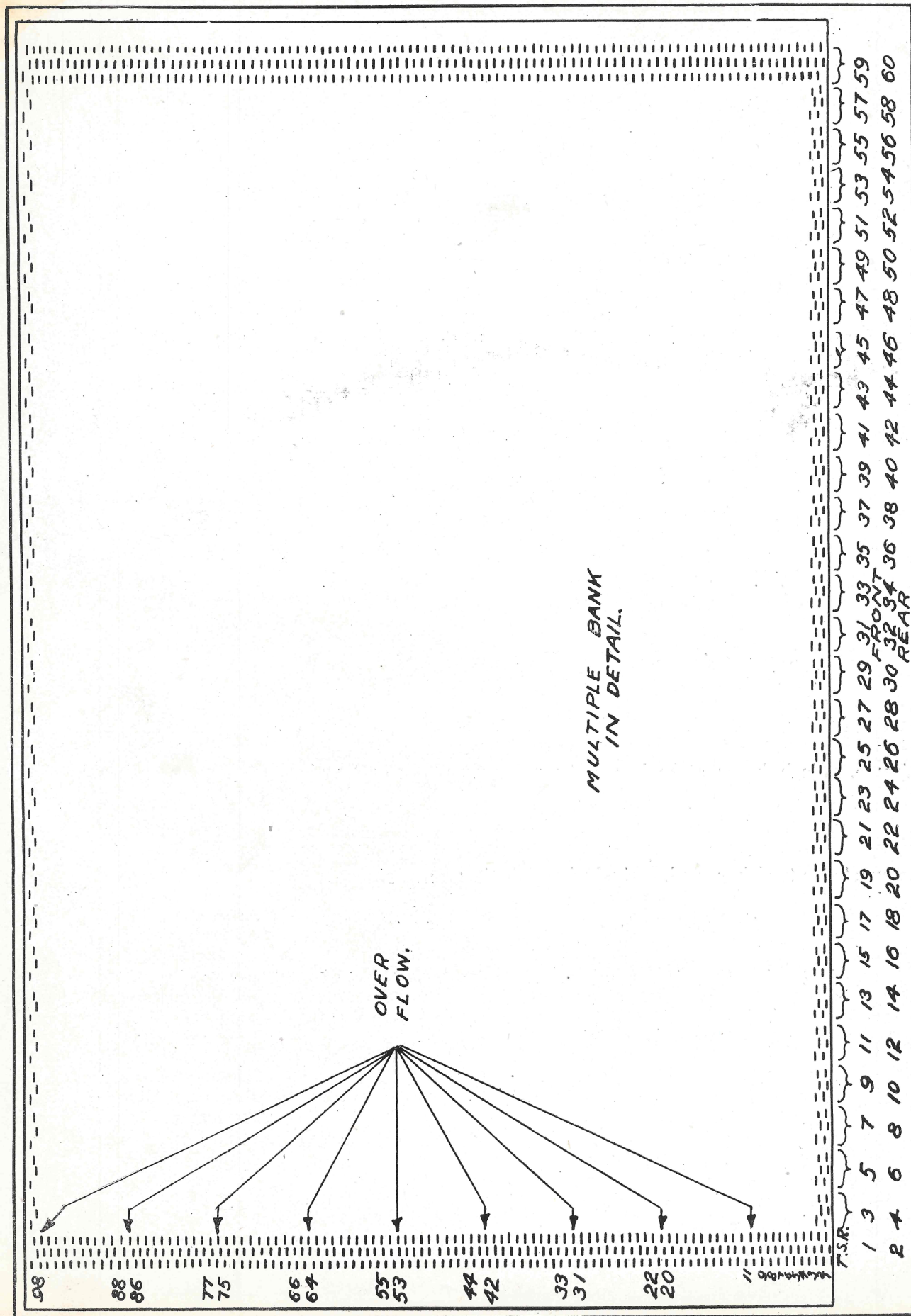


FIGURE 7.1032

THE CONSTRUCTION OF A MULTIPLE BANK.

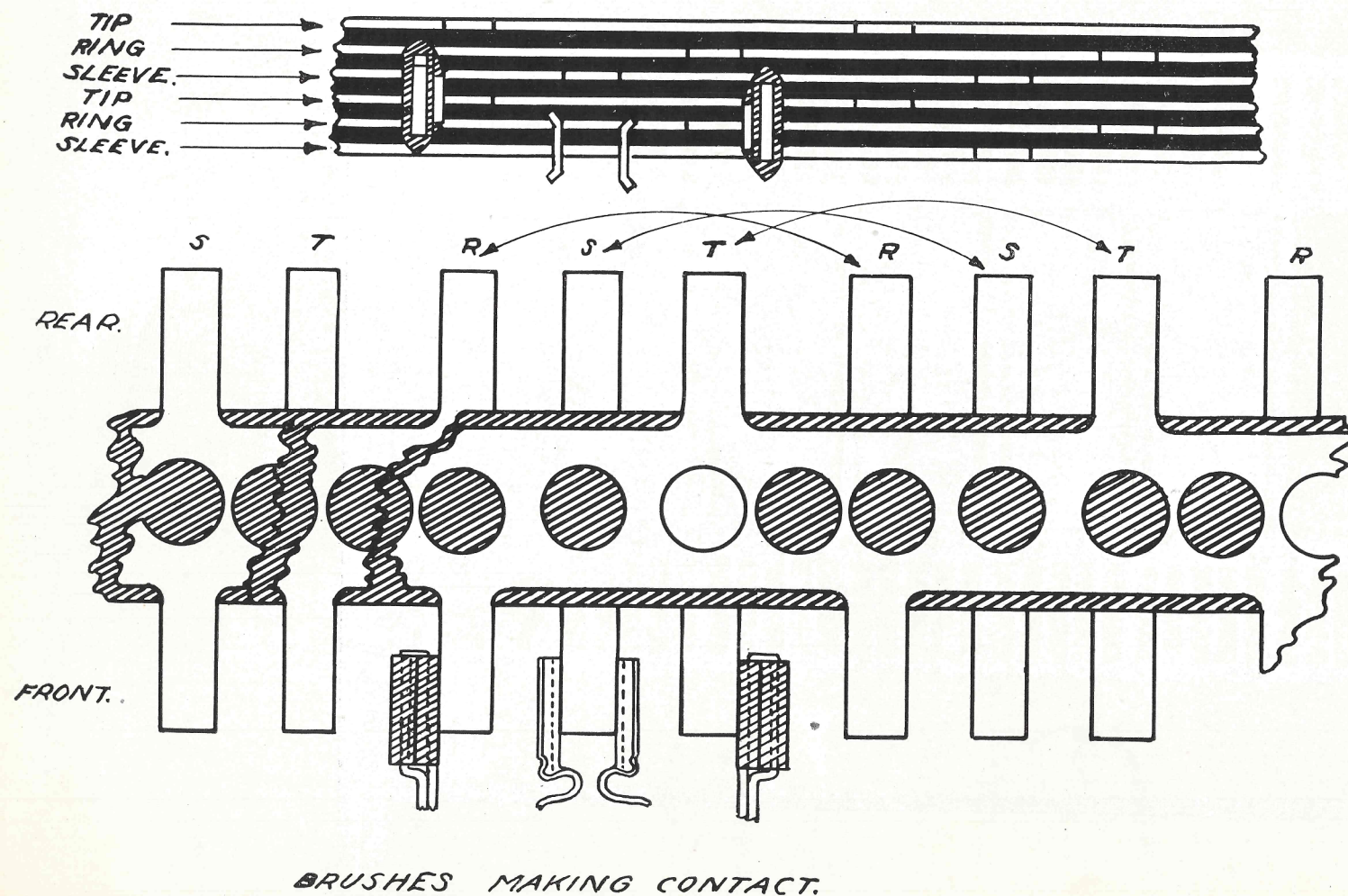


FIGURE 7.1033

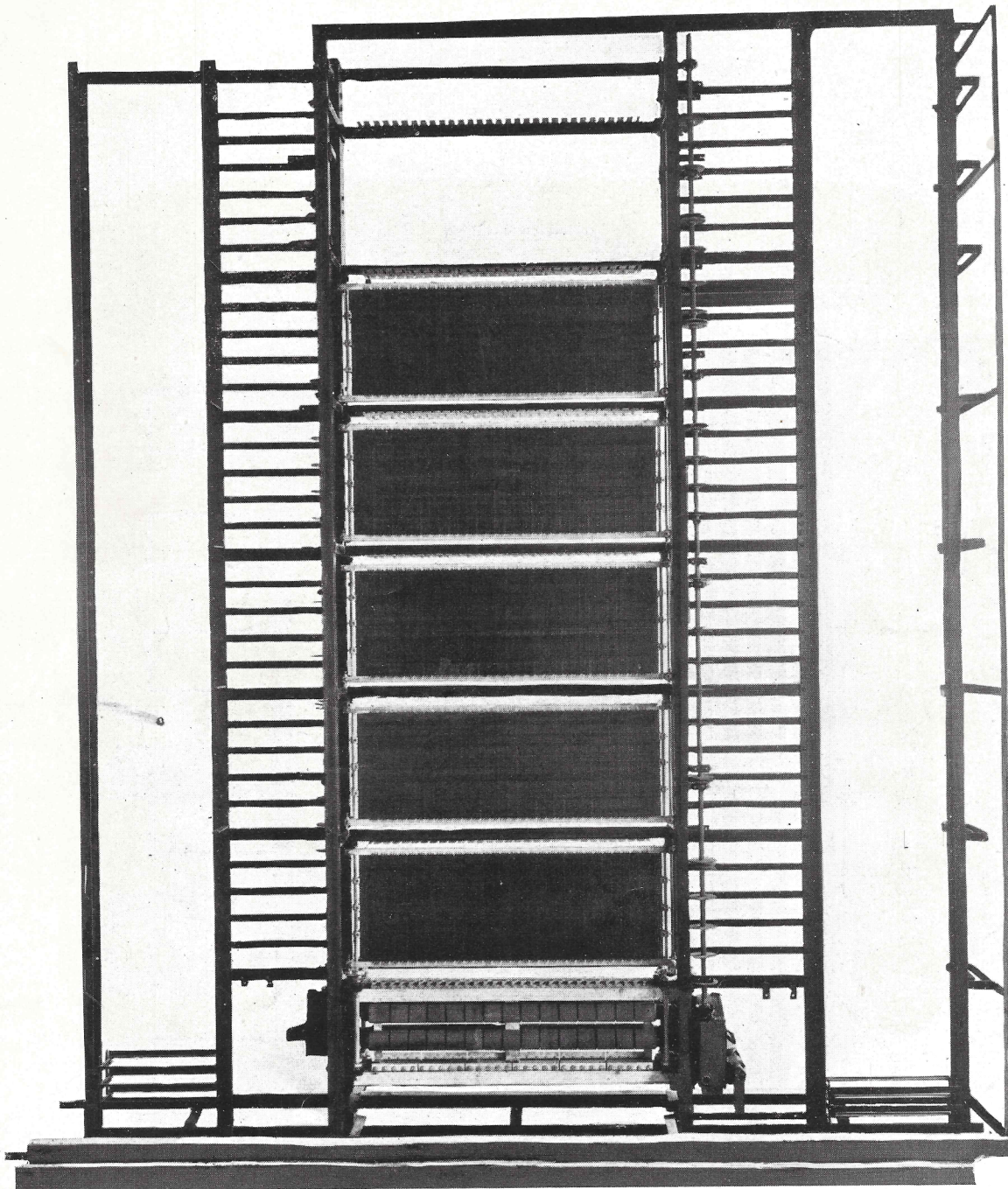


FIGURE 7.1034
Multiple banks mounted in a typical Selector Frame.

Issue
11-1-21

LINE FINDER BANKS

T.D.M.
7.104

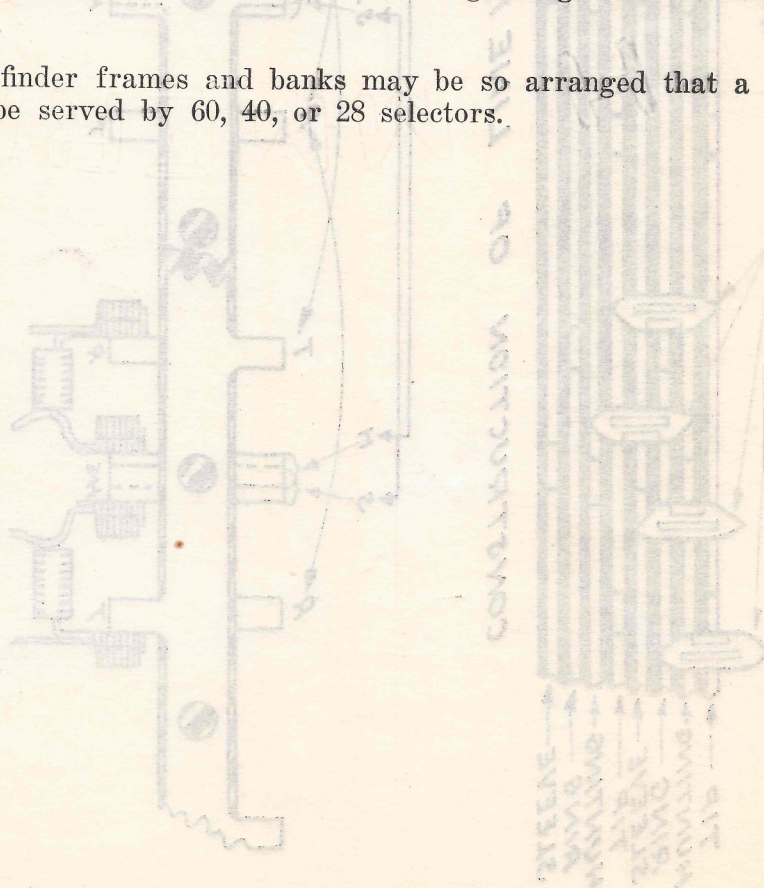
Line Finder banks are similar in construction to regular multiple banks, but are 20 lines high rather than 100 high. Also, the circuits are four conductor circuits, consisting of Tip, Ring, Sleeve, and Hunt terminals. Construction of the Line Finder Bank is shown on illustrations 7.1041 and 7.1042.

Line finder frames mount fifteen banks one above another, and are arranged to use 56 or 60 selectors. When such a frame is equipped with straight banks, 300 subscribers lines are connected to the terminals of the banks. This straight type of bank is provided with a cross connecting cut in the middle of the bank, so that the order of terminals is reversed. That is, the O line will be the bottom terminal in one section of the bank, but will be the top terminal in the other section. 60 selectors are used with this equipment.

A second type of bank is used wherein the bank is cut electrically into two sections, each section being provided with a cross connecting cut. When a frame is equipped with this type of bank only 56 selectors are used, and 600 subscribers lines are connected to the banks.

Still another type of bank is used wherein the bank is cut electrically between the 40th and 41st terminal, the 40 terminal section being provided with a cross connecting cut. With this equipment 60 selectors are mounted on a frame, two frames serving 900 subscribers' lines. With this arrangement the 20 terminal sections of the two frames are connected together, the cross connecting or terminal reversing being done in the local cabling.

To summarize, the line finder frames and banks may be so arranged that a group of 300 subscribers' lines will be served by 60, 40, or 28 selectors.



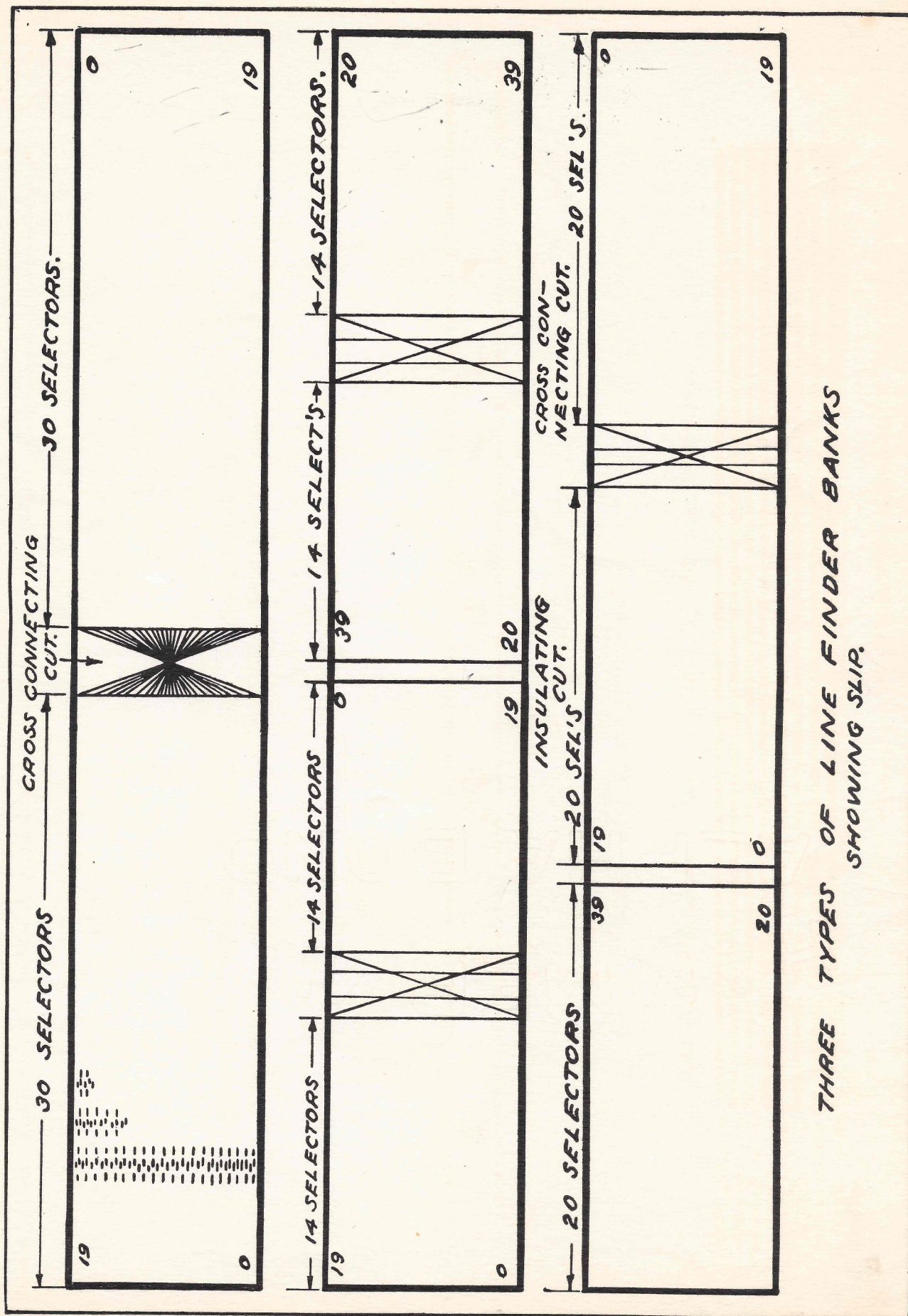


FIGURE 7.1042

The elevator rod is moved up and down by means of a flat metal strip known as the rack, which is fastened to the bottom of the elevator rod. The rack is placed directly in front of the revolving cork rolls of the friction drive apparatus. These rolls rotate in opposite directions. On the other side of the rack are small metal rollers, attached through a lever system to the armatures of the up and down drive clutch magnets. When a clutch magnet operates, the movement of its armature causes the small roller to press the rack against one of the constantly revolving cork rolls. This results in the upward or downward movement of the elevator rod. The clutch is shown on illustration 7.1055.

The tripping of the desired multiple brush is accomplished by means of the trip rod and its associated trip fingers. The trip rod is a small metal rod mounted vertically, directly behind the elevator rod, and arranged so that it can be rotated, but held rigid as regards up and down movement. The trip rod has a trip finger associated with each multiple brush; but each trip finger is set at a different height relative to its associated brush. In selecting a particular brush, the up-drive magnet operates, under control of the sender, moving the elevator upward a number of steps corresponding to the brush desired; that is, one step for the first brush, two steps for the second brush, etc. The sender then causes the clutch magnet to release, thus stopping the upward movement of the elevator. The trip lever of the desired brush is now directly opposite its trip finger, while the trip levers of the other brushes are either above or below their respective trip fingers. The various positions of the trip fingers and brushes are shown on illustrations 7.1052 and 7.1053.

The trip magnet, which is located on the clutch frame immediately above the down-drive magnet, now operates and causes the trip rod to rotate and the trip lever of the desired brush to be engaged by its trip finger, which is directly opposite it. The trip fingers are equipped with small coil springs, thus preventing more than one trip finger from engaging with its trip lever at one time. The trip finger so engaged is stopped half way through its normal arc of travel, the coil spring allowing the trip finger to remain stationary while the trip rod continues to rotate through its complete arc of travel, carrying the other trip fingers around with it. On the next upward movement of the elevator, which will be when making group selection, the brush whose trip lever was engaged by its trip finger will be tripped and put in contact position.

The up-drive magnet operates again, under control of the sender, moving the elevator upward for selection of a group of trunks. When the first trunk of the desired group is reached, the sender causes the up-drive magnet to release, as in brush selection.

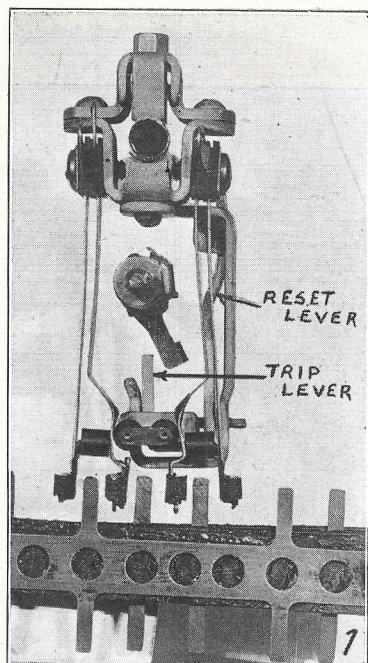
It is now necessary for the selector to find an idle trunk in the selected group. If the first trunk of the group happens to be idle, this is already accomplished; but if the first trunk is busy, it is necessary for the multiple brush to hunt over the terminals of the other trunks in the group until an idle one is found. For this operation, the up-drive magnet is again energized, but this time it is controlled by the selector itself and not by the sender. As soon as the first idle trunk is reached, the up-drive magnet is caused to release, thus stopping the brush on the terminals of the idle trunk.

There is one type of selector, known as the final selector, which picks out a particular line from a group of ten instead of hunting for an idle trunk. This operation is called units selection and is carried out under control of the sender in the same manner as brush or group

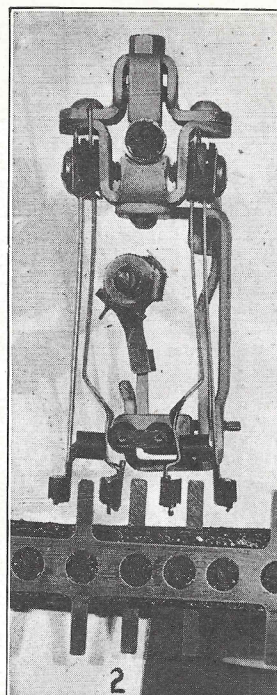
selection. However, since the intervals between adjacent sets of terminals are too small to permit accurate control of the selection by the sender when the elevator moves upward at normal speed, provision is made for moving the elevator upward at a lower speed during units selection by adding a low-speed up-drive friction roll and clutch magnet.

Each selector frame is provided with two sets of friction rolls, one for driving the 30 selectors on one side and the other for driving the 30 selectors on the opposite side. The rolls are steel shafts covered with a layer of cork and are mounted horizontally below the multiple banks. On trunk-hunting frames, there are two rolls in a set placed one above the other and geared so as to rotate in opposite directions. On individual line selecting frames, there are three rolls in a set: down-drive, up-drive, and low-speed up-drive.

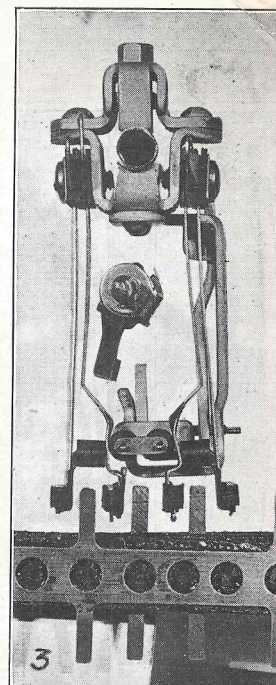
The friction rolls are driven by gears from small motors. One motor is provided for each selector frame; but, in order to avoid putting a selector frame completely out of service in case a motor stops, one motor is arranged to drive the selectors on the same side of two adjacent frames. Where an odd number of selector frames are located in a line, the odd frame is equipped with two motors, each one driving half the selectors. Each motor is provided with an alarm, which functions in case it stops.



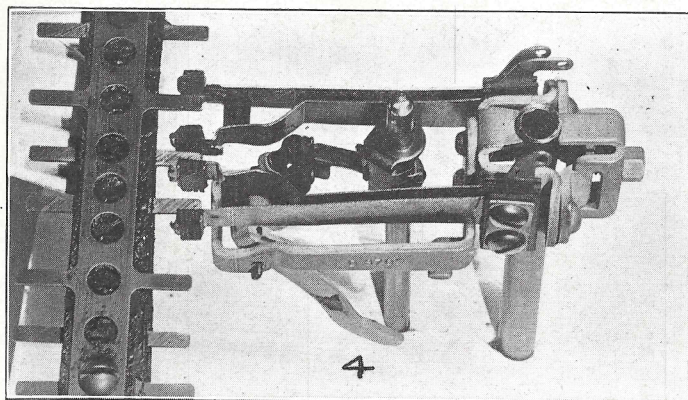
—A—
Relation of bank and brush—showing brush in normal position. Trip magnet normal—trip finger normal.



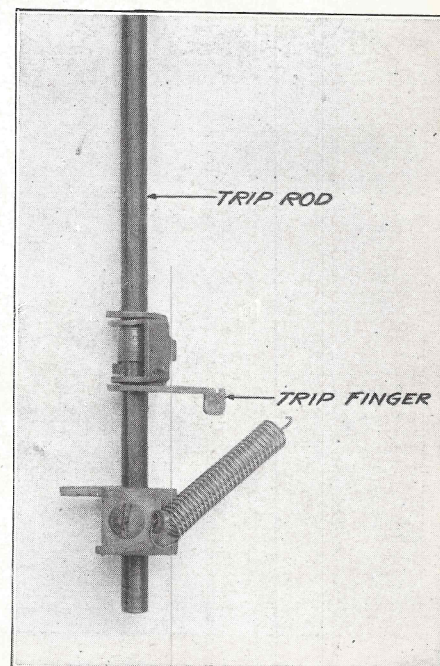
—B—
Trip magnet operated—
Trip finger engaged.



—C—
Trip magnet operated—
Trip finger not engaged.



—D—
Relation of bank and brush—showing brush in tripped position.



—E—
Trip rod assembly—showing spring used in returning trip rod to normal and trip finger spring.

FIGURE 7.1053

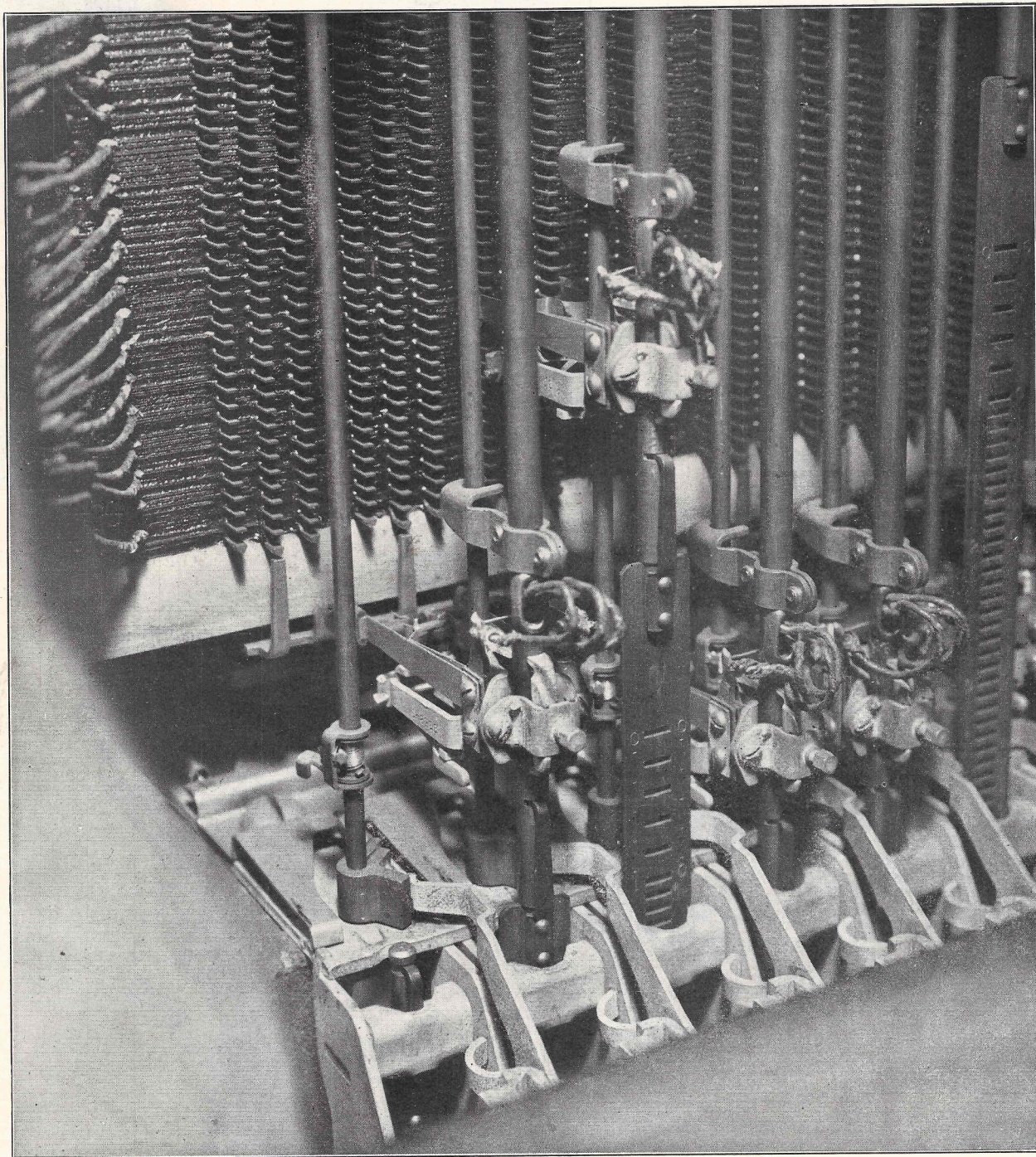


FIGURE 7.1054
Relation of rack, clutch, brush, and multiple bank.

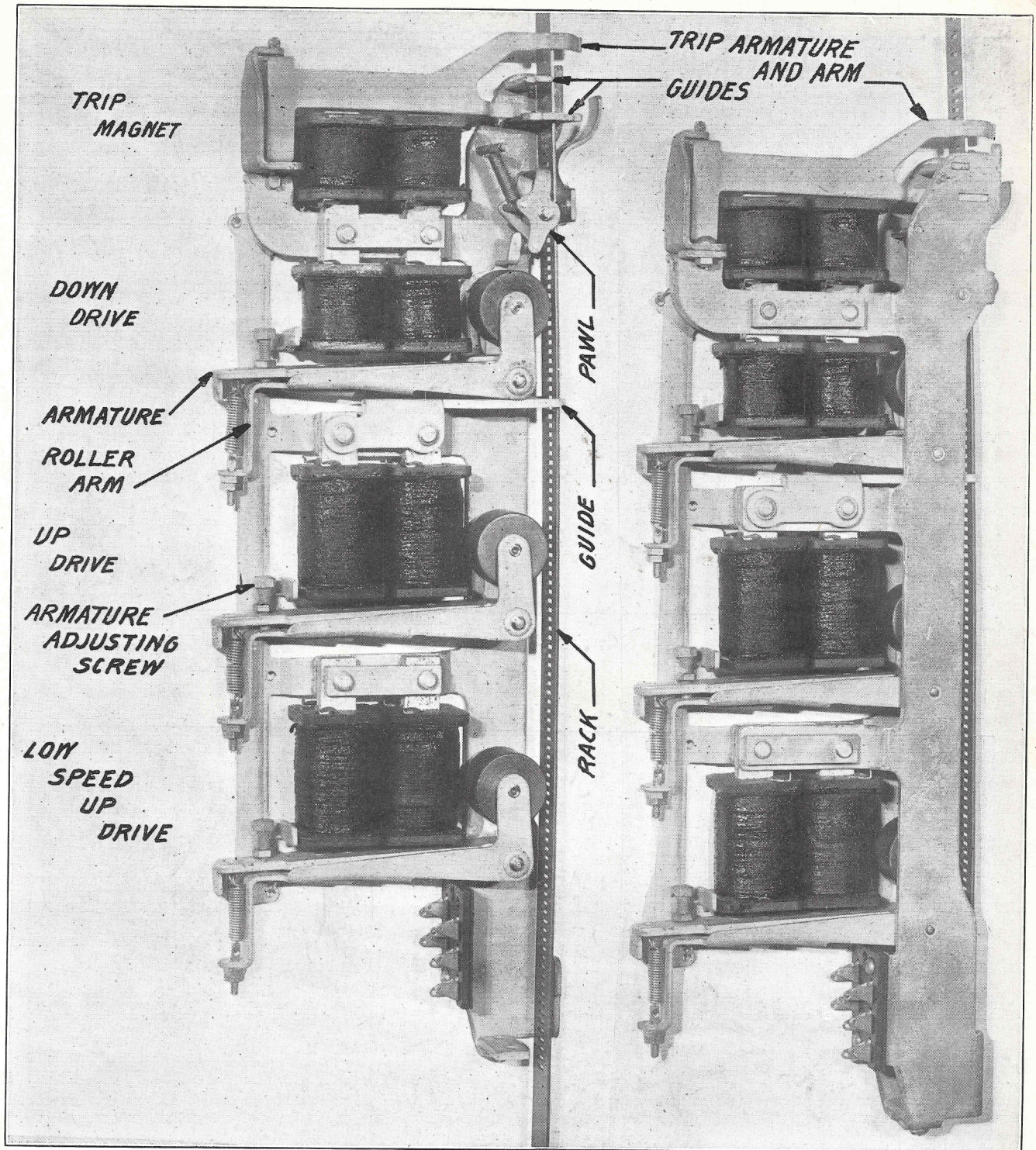
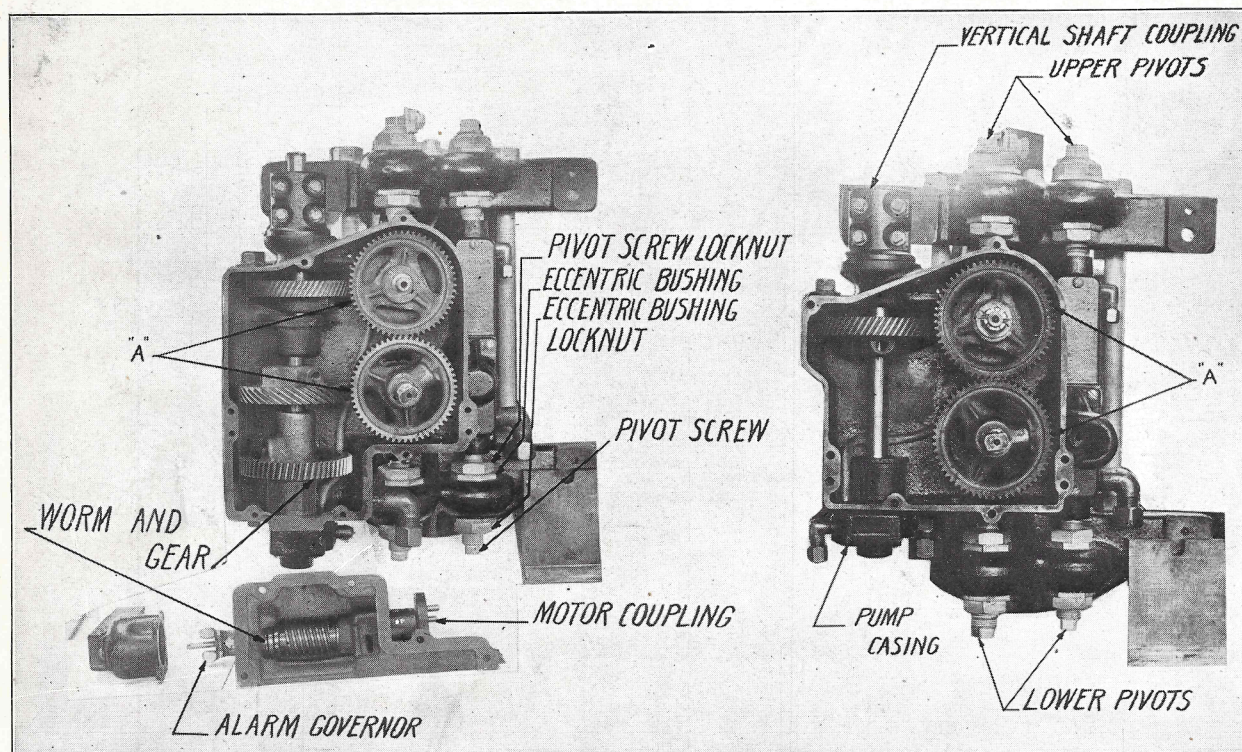


FIGURE 7.1055

The clutch used on final frames—showing relation of rack, rollers, pawl, and armatures.



Gearing of friction roll drives.

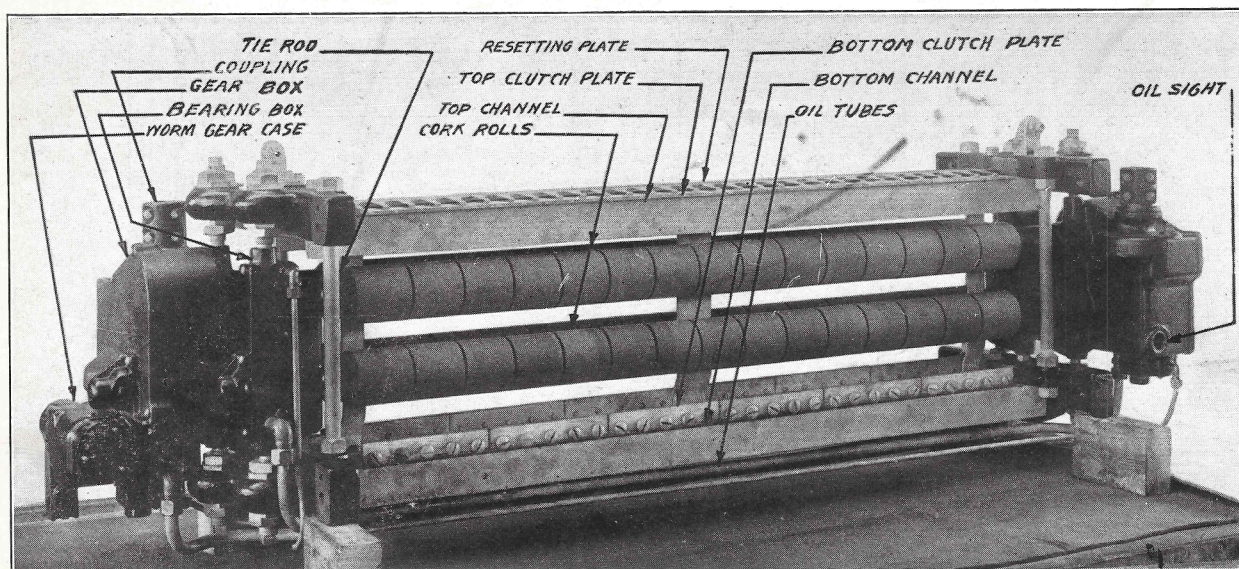


FIGURE 7.1056

Friction roll drive unit complete, ready to mount in frame.

Issue
11-1-21

THE COMMUTATOR

T.D.M.
7.106

The commutator used on selector frames consists of a flat bar of insulating material in both sides of which are imbedded a number of metal contact strips. These strips are the commutator segments, but each strip is generally spoken of as a commutator. Illustration 7.1061 shows a typical commutator, the one used on the district and office frames, while illustration 7.1062 shows a final frame commutator with brush. The commutators on the various selector frames differ slightly on account of their different functions, but they are similar enough to need no separate description.

The rear of the commutator shown on figure 7.1061, known as the feeder side, contains five narrow contact strips called the "T", "R", "S", "G", and "O" commutators; the front of the commutator, called the interrupter side, contains three wide slotted contact strips known as the "A" and "Z", the "B", and the "C" commutators, and two small segments called the "X" and "Y" commutators.

The tip, ring, and sleeve wires of the incoming trunk are connected to the "T", "R", and "S" commutators respectively. The corresponding springs of the commutator brush make contact with these commutators and complete the circuit, through the springs of the tripped multiple brush and the contacts of the multiple bank, to the tip, ring, and sleeve wires of the selected out-going trunk or line. The "G" commutator supplies ground to the other commutators, except "T", "R", and "S", by means of straps connecting their brushes. The "O" commutator is the "sleeve-make-busy" commutator.

The "A" and "B" commutators are used in brush and group selections respectively, connecting ground via the commutator brushes to the sender and thereby controlling the motion of the elevator. When the proper number of successive ground pulses have been passed back, the sender causes the up-drive magnet to release. The "C" commutator is the centering and trunk-hunting commutator and prevents the up-drive magnet from releasing until the multiple brush springs are squarely centered on the selected terminals of the multiple bank. The "Z" commutator is the overflow commutator and functions when all the trunks in the selected group are busy. The "X" commutator functions when the selector goes to "tell-tale", that is, when the elevator goes all the way to the top. The "Y" commutator is the "return-to normal" commutator and serves to restore the sequence switch to normal after the elevator has returned to its normal position.

On the final frame, in place of the "Z" commutator, there is the "U" commutator, which functions during units selection in the same way as the "A" and "B" commutators do during brush and group selections. On the incoming frame, instead of the "O" commutator, there is the "P" commutator, which controls party-line ringing.

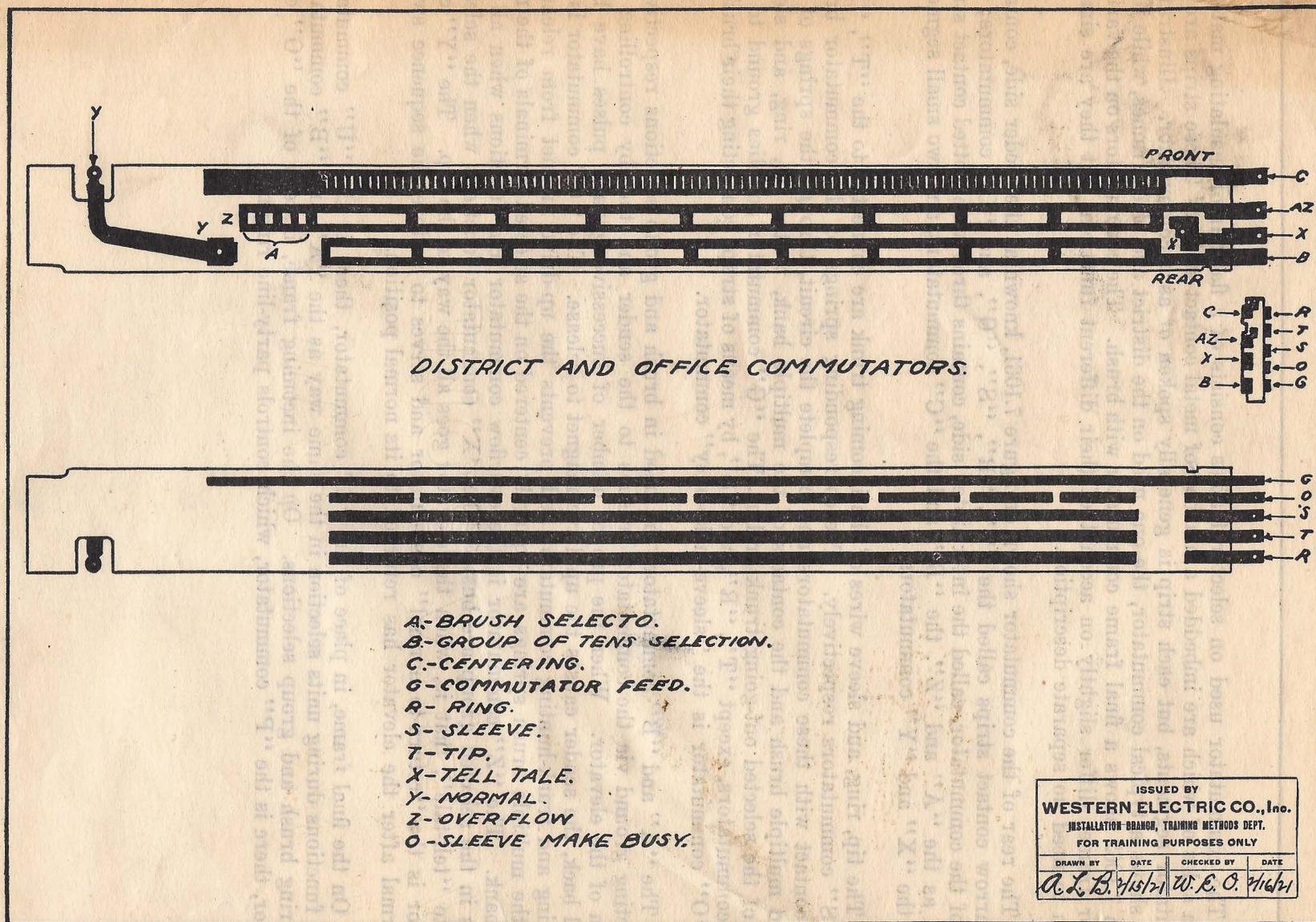


FIGURE 7.1061

In the operation of a selector or other mechanism used in machine switching units, it is frequently necessary to open, close, or change the direction of several circuits either at the same instant or in a definite sequence. This might be done by the use of relays, but the number of relays needed would be prohibitive. Accordingly, the sequence switch was developed to perform certain routine switching functions. The sequence switch is a rotary switch which, during a complete revolution, passes through 18 successive stop positions, each one of which may give different circuit combinations, position one being the normal position of the switch.

A sequence switch, shown on illustration 7.1071, comprises a number of discs, called cams, mounted at regular intervals on a horizontal square shaft and separated from each other by small metal collars. The shaft is rotated by means of a friction disc mounted on a flexible spider at the left end of the shaft. When a clutch magnet is operated, the friction disc is brought into contact with a driving disc attached to a constantly revolving vertical shaft. The switch continues to rotate as long as the clutch or "R" magnet remains energized, but stops the instant it releases. There is an indicating wheel mounted on the right end of the shaft with a stationary pointer to indicate in which of its 18 positions the switch is resting.

A sequence switch cam is made up of a circular insulating disc between two metal plates, the three being riveted together so that the metal plates are electrically connected. The tips of two springs rest on each side of the cam, one spring being nearer the center of the cam than the other. The four springs associated with each cam are named, according to their positions, lower inner, lower outer, upper outer and upper inner, lower meaning the side toward the "R" magnet and upper the side away from the magnet. The metal plates on each side of the cam have pieces or segments cut out of them so that, as the switch rotates, the springs may rest either on the metal plates or on the insulating disc. In this way, various circuits can be opened or closed either simultaneously or consecutively, the timing being positive in all cases.

The cams are designated from left to right by the letters "A," "B," "C," etc. They are insulated from the shaft and from each other, except where circuit requirements make it necessary to connect two or more adjacent cams together. The collar between two cams that are insulated from each other is made with a small groove on its face, while the collar between two electrically connected cams is plain.

The "A" cam differs from the others in that it has only one metal plate attached to the insulating disc. It also embodies a mechanical device for holding the switch centered in the desired stop position after the "R" magnet releases. The purpose of the "A" cam is to keep the "R" magnet energized from the time the switch leaves one position until it enters the next, thus preventing the switch from stopping between positions.

Sequence switches have a capacity of 24 cams besides the "A" cam, but only as many cams are mounted on the shaft as circuit requirements call for.

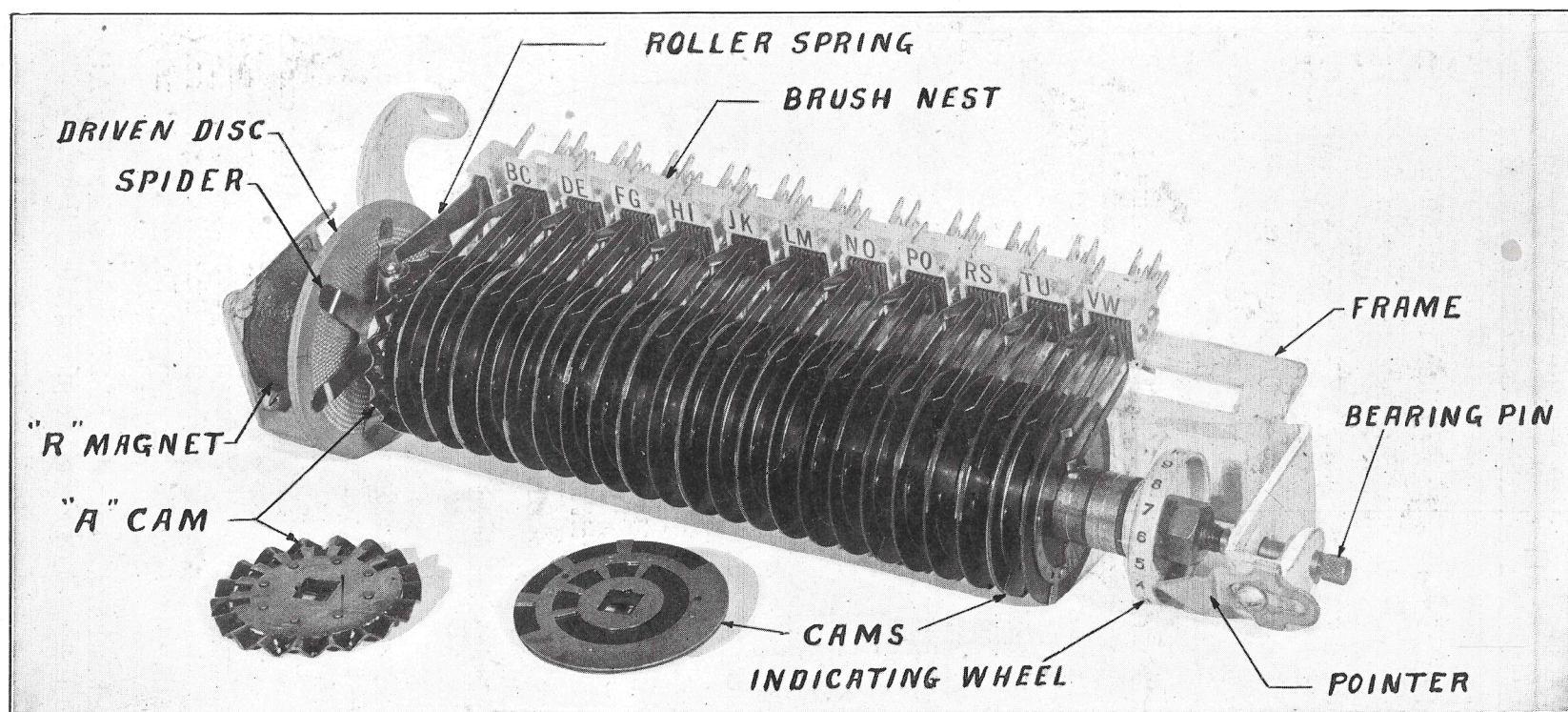


FIGURE 7.1071
The sequence switch.

Issue
11-1-21

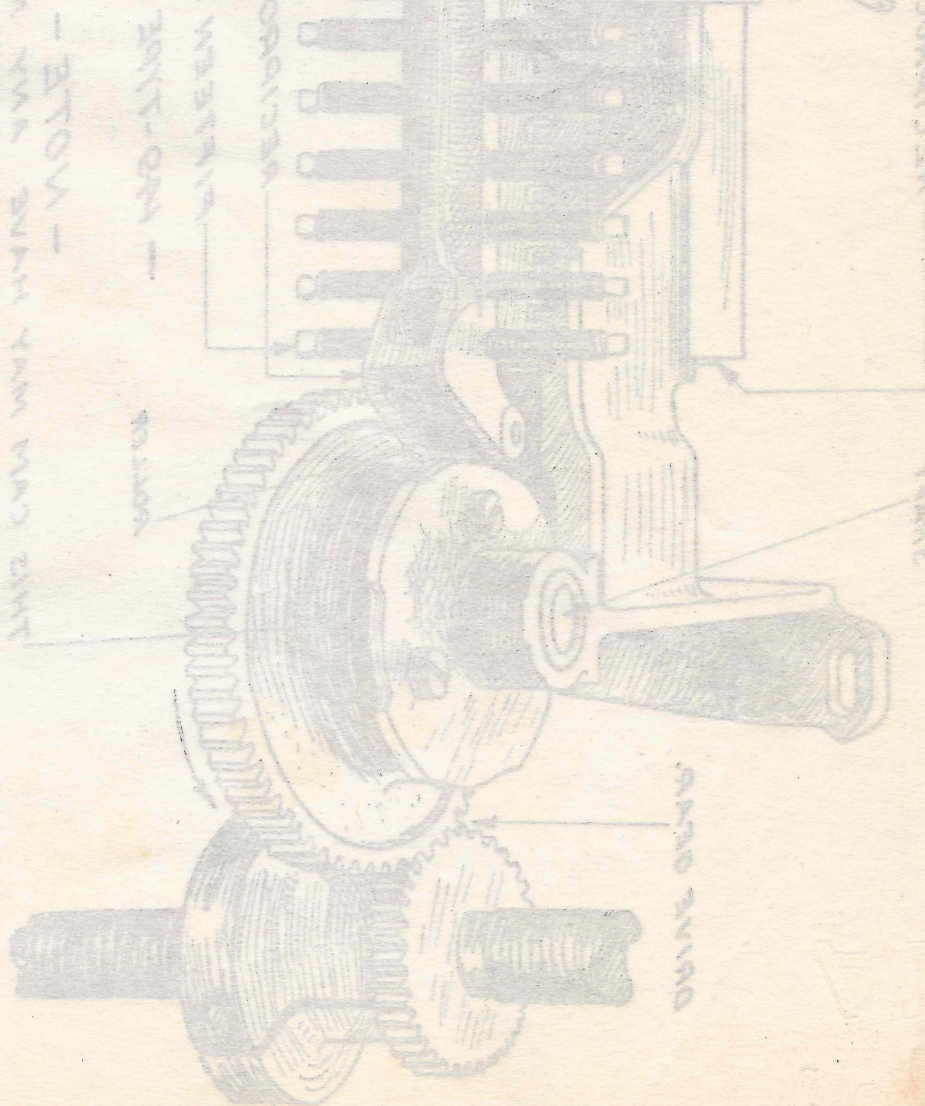
THE INTERRUPTER

T.D.M.
7.108

The power-driven interrupter, shown on figure 7.1081, is a device for furnishing interrupted current with definite make and break periods to some of the circuits in a machine-switching system. It is mounted on the selector frame and is actuated by a cam which is geared to the sequence switch drive shaft. A roller rides on the periphery of the cam and is mounted on a reciprocating bar which is attached to the frame of the interrupter by flat springs.

The interrupter consists of spring assemblies in which contacts are made and broken by means of insulated studs fastened to the reciprocating bar. The springs may be arranged to give various contact combinations, as break, break-make, etc. The rate of interruption and the proportion of make and break of contacts is determined by the gear ratio and the shape of the cam.

Each interrupter mounting has a capacity of 30 sets of springs, but may be equipped with any number from 1 to 30, as required.



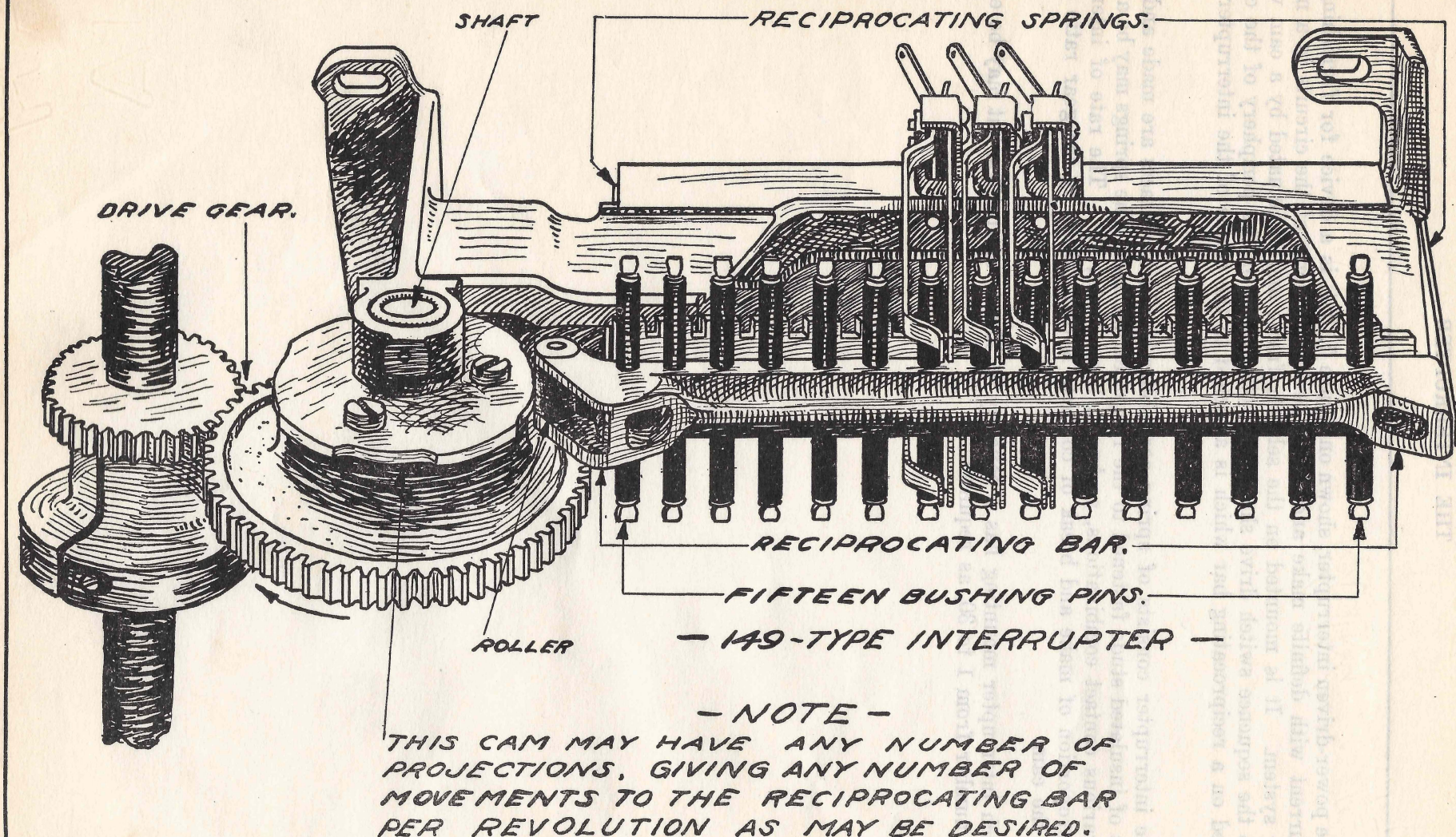


FIGURE 7.1081

Issue
11-1-21

THE SELECTOR SWITCH

T.D.M.
7.109

The selector switch is a step-by-step rotary switch by means of which one set of leads may be connected through to any one of a number of sets of leads. The switch, shown on illustration 7.1091, has a horizontal shaft carrying six brushes which, when the shaft is rotated, wipe over arcs of terminals mounted radially in a semicircular bank which is concentric with the shaft. The terminals of the bank extend through the mounting, the projections upon the inside providing wiping contacts for the brushes and those on the outside forming soldering lugs for wiring. The bank has a capacity of six arcs of 23 terminals each, and the first group of six terminals, known as the feeder terminals, is used to make connection with the brushes. This is done by means of flat springs resting on slip rings.

The contact brush for each arc of terminals consists of two flat metal springs which press against the opposite sides of the terminal on which they are resting. Brushes may be bridging or non-bridging, the former being designed so that contact with one terminal is held until contact with the next terminal is made. At the mounting shaft, the brush springs are formed to provide the slip rings on which the feeder springs rest.

The brush shaft is rotated by means of a stepping magnet, which may be made self-interrupting, and which acts through a pawl and ratchet wheel to rotate the shaft. When the magnet operates, the pawl is advanced one tooth on the ratchet wheel; and when the magnet is released and the armature falls back, the tension of a retractile spring drives the pawl inward and advances the ratchet wheel one cog, moving the brush assembly to the next set of terminals. An indicator wheel is provided to show on which set of terminals the brushes are resting.

Selector switches of the type described are used as line switches, sender selectors, registers in the sender circuits, and as control switches in various circuits. When used as line switches, they are furnished with four arcs of individual terminals and two arcs of strap terminals. When used for other purposes, from two to six arcs of individual terminals are provided.

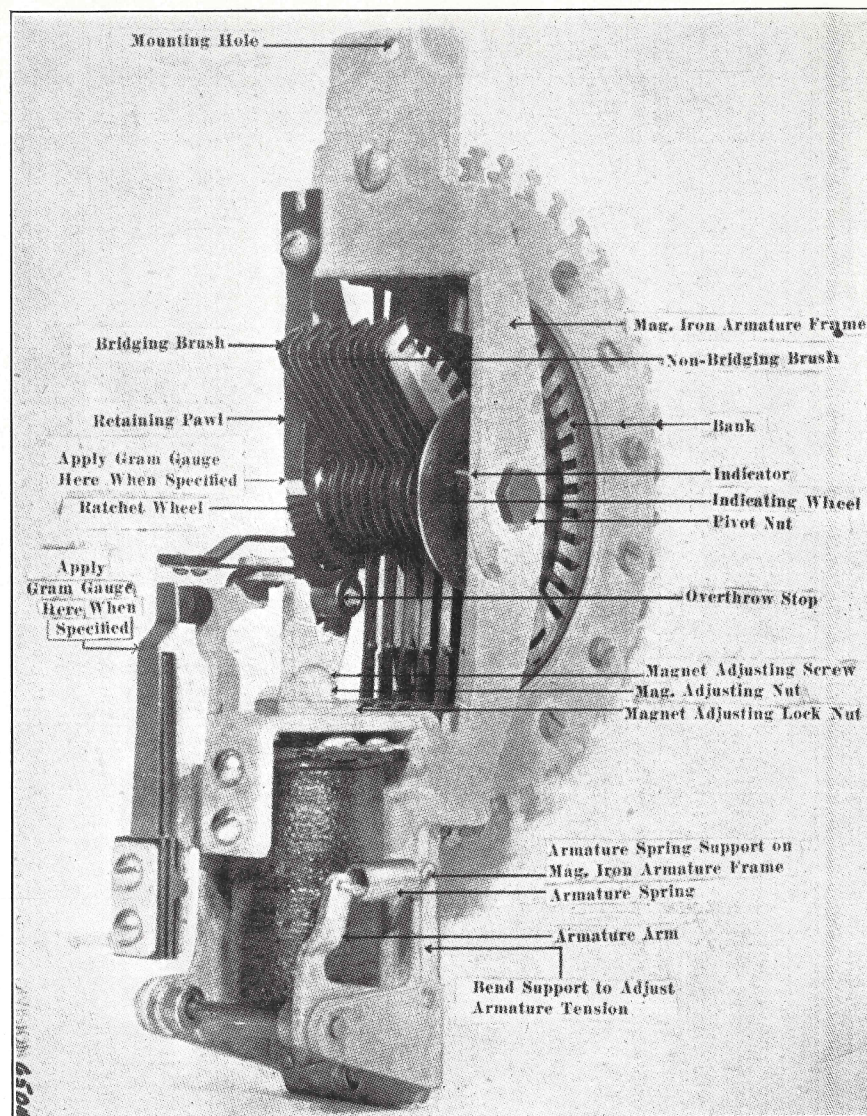
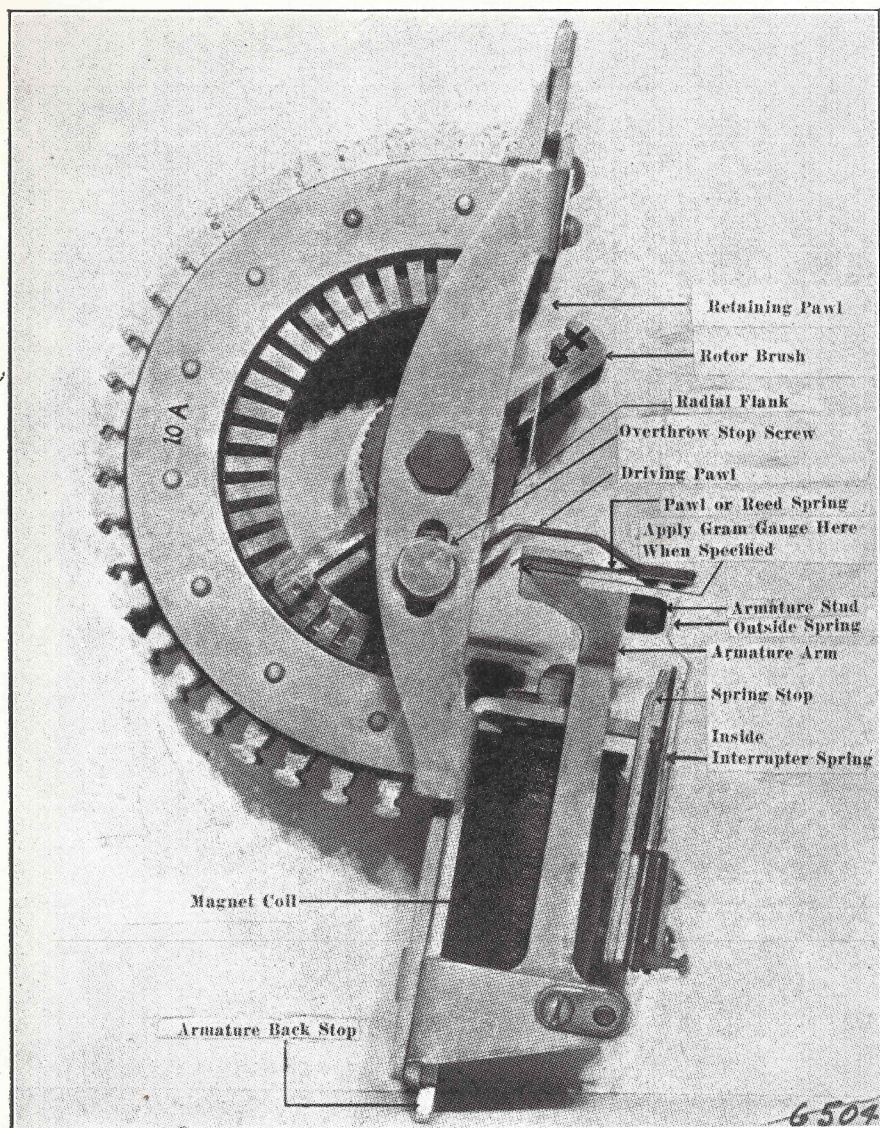


FIGURE 7.1091
The 200 type selector switch.

There are several kinds of panel-type selector frames used in a machine switching system. For a full-mechanical call, four different frames are generally required, which are known as the district frame, the office frame, the incoming frame, and the final frame. The other kinds of frames are, in general, merely modifications of one of these four for a special purpose, such as calls from manual to mechanical offices. Illustration 7.1101 shows a typical selector frame, and illustration 7.1102 shows a number of frames in the process of installation.

It is necessary to distinguish between the terms "selector" and "selector frame." A selector is merely the selecting mechanism, consisting of the pieces of apparatus enumerated in 7.105, while a selector frame includes the multiple banks as well as a number of selectors, generally 60. Selectors on district frames are known as district selectors, those on office frames as office selectors, etc.

It frequently happens that the 60 selectors on one frame are not sufficient to handle all the traffic over the trunks or lines terminating on the multiple banks of the frame. In this case, the multiple banks of a number of frames may be connected in parallel, or a split bank may be connected in parallel with a full bank, in order to obtain enough selectors to handle the traffic. In any case, all the sets of terminals that are connected in parallel, whether forming a part of one frame, a whole frame, or more than one frame, are known as a multiple; and the selectors that establish connection with the terminals in one multiple, whether on one frame or on more than one, are called a group of selectors.

The order of selection in a full-mechanical call is as follows: the line switch or line finder connects the calling line to an idle district selector; the district selector routes the call to an office selector, which in turn establishes connection with an incoming selector in the office of the called subscriber; the incoming selector picks a final selector in the group which serves the final multiple in which the called line appears; and the final selector completes the selection of the called line. This process will be considered in greater detail in the next few sections.

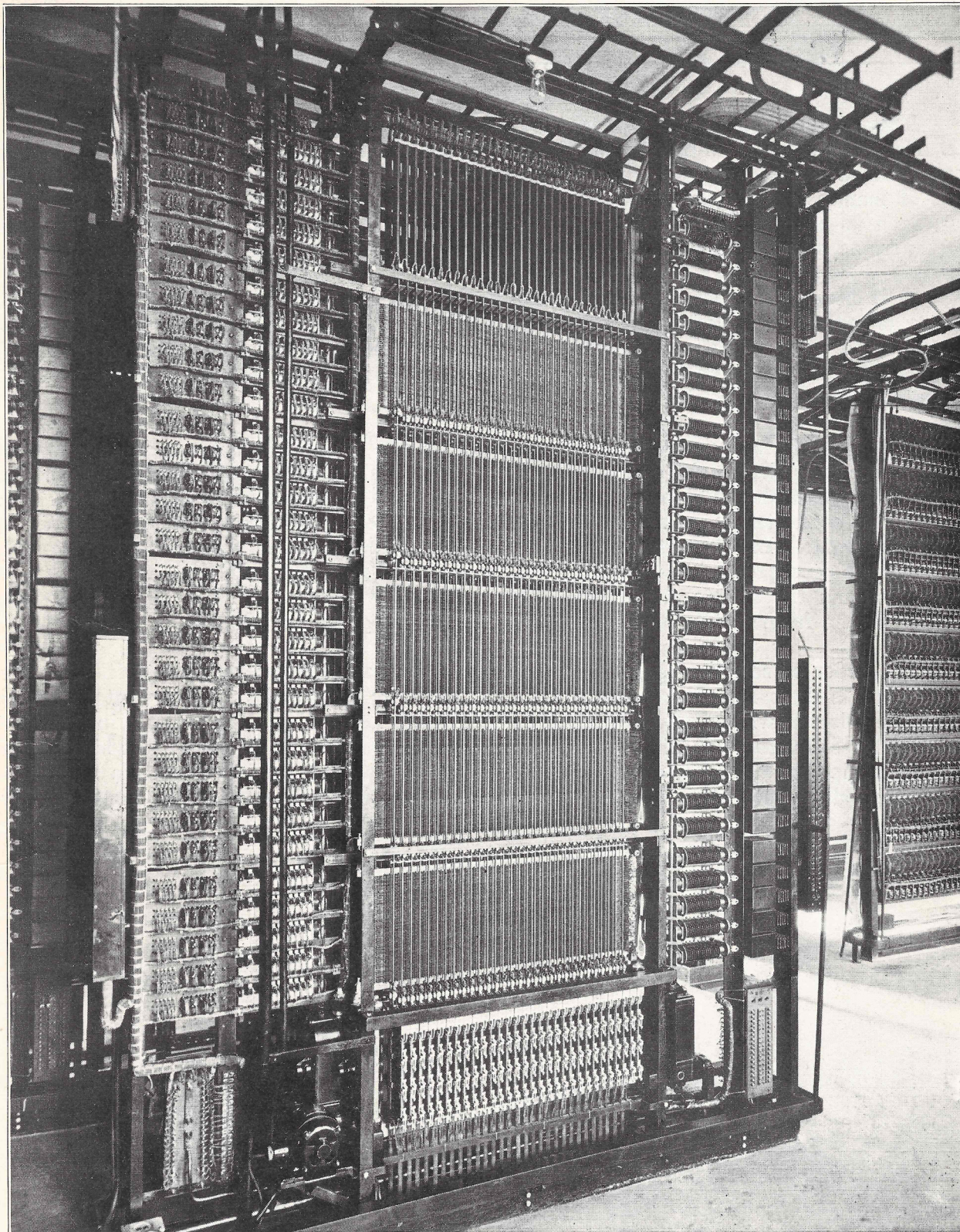


FIGURE 7.1101
A final selector frame.

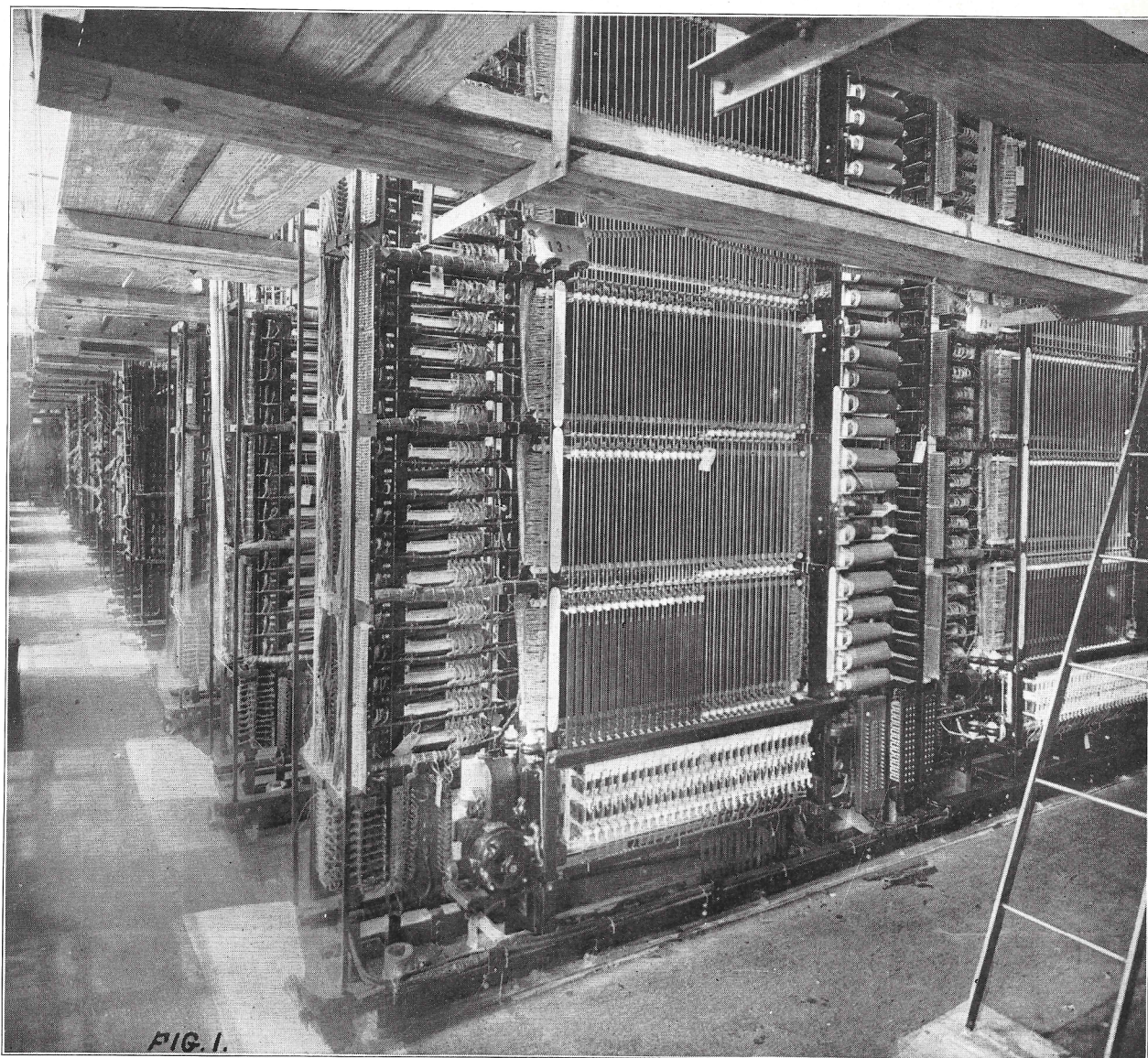


FIGURE 7.1102

A machine switching office being installed.

Issue
11-1-21

THE DISTRICT SELECTOR FRAME

T.D.M.
7.111

The district frame is the first selector frame used in the routing of a mechanical call. The selectors on a district frame are of the trunk-hunting type, which is described in section 7.105. Each district selector has a sender selector associated with it, and the sender selector must pick an idle sender before the calling subscriber can dial.

The leads from a line finder or from a set of terminals on a line switch bank are connected to a district selector and terminate, via the sequence switch and commutator, at the multiple brushes of the selector. Local outgoing trunks, each of which is connected to an office selector or directly to an incoming selector, originate on the multiple banks of the district frames. Calls that are routed direct from the district frames to incoming frames are known as skip-office calls. All local calls, as well as calls to some nearby exchanges to which the traffic is heavy, are of this class.

The 100 sets of terminals on each multiple bank of a district frame are arbitrarily divided into 9 groups, each group containing 11 sets of terminals. The top set in each group, known as the overflow terminals, is used to give a busy signal in case all the trunks in the group are busy, and also to cause the up-drive magnet to release, thus preventing the multiple brush from moving up into the next set of trunks. Deducting the 9 sets of overflow terminals, the capacity of each bank is 90 working trunks, the top set of terminals of each bank being left blank.

A group of trunks may contain any number of trunks up to 90. Groups of more than 10 trunks are obtained by making one or more sets of overflow terminals test busy, in order that the trunk hunting may be carried from one group of 10 up into the next. Accordingly, it is possible so to wire the five multiple banks of a district frame as to obtain trunk groups of any size between the limits of 45 groups of 10 trunks each and 5 groups of 90 trunks each. All the trunks in a group lead to selectors in the same group; that is, to selectors on one frame or on frames whose banks are multiplied together.

Additional functions of a district selector are to furnish talking current to the calling subscriber and to give a busy tone in case all the trunks in the desired direction, during any of the selections, are busy.

Issue
11-1-21

THE OFFICE SELECTOR FRAME

T.D.M.
7.112

The office frame is used on inter-office calls to establish connection with incoming selectors in the office of the called subscriber, and it is always in the same central office as the district frames that trunk to it. Office selectors are of the trunk-hunting type. Each trunk incoming from the district multiple terminates, via the sequence switch and commutator, on the multiple brushes of an office selector. Outgoing inter-office trunks, each one of which is connected to a selector on an incoming frame, originate on the multiple banks of the office frames.

The 100 sets of terminals in each multiple bank of an office frame are divided into 9 groups of 11 sets each, just as in the case of the district frame, and the same combinations of trunk groups can be obtained.

Office frames are used only in central offices where the number of outgoing trunks is so great that there is not room for all of them on the district multiple. It is obvious that office frames must be used whenever the number of groups of trunks originating in an office exceeds 45; but, even when the number of groups of trunks is considerably less than 45, it is frequently found more economical to use office frames. If office frames were not used, and there were more than 450 outgoing trunks, it would be necessary to split up each group of trunks among two or more groups of district frames; but, in that case, each subscriber would have access to only a fraction of the trunks in each group.

One of the fundamental principles of telephone traffic states that the greater the percentage of trunks in a group to which each subscriber has access, or, in other words, the greater the number of subscribers who have access to each trunk, the higher is the efficiency of each individual trunk, the efficiency being measured by the amount of time during which the trunk is in use. This means that a considerably greater volume of traffic can be carried by one trunk group of a certain size than by two groups, each of half that size.

The use of office frames makes it possible to give every subscriber in an office access to all the trunks in each group, provided, of course, that a group does not contain more than 90 trunks, in which case it must necessarily be split. The greatest possible number of calls, however, are handled on a skip-office basis, thus decreasing the number of office selectors which must be provided and also lowering the average time required to complete a connection. For this reason, the large groups of trunks, over which traffic is consistently heavy, are, to as great an extent as possible, placed directly on the district multiple; and the smaller groups, over which traffic is lighter and less uniform, are placed on the office multiple.

Issue
11-1-21

THE INCOMING SELECTOR FRAME

T.D.M.
7.113

The incoming frame used on a certain call is always in the office of the called subscriber, and it performs the first part of the selection of the desired line from among the 10,000 lines terminating in that office. Incoming selectors are of the trunk-hunting type. Local or inter-office trunks incoming from district or office multiples terminate, via the sequence switch and commutator, at the multiple brushes of the incoming selectors. Local trunks, each of which is connected to a selector on a final frame, originate on the multiple banks of the incoming frames.

The capacity of each final frame or set of final multiple is 500 lines; so, in order to care for a fully equipped unit of 10,000 stations, 20 sets of final multiple are needed, requiring 20 groups of final selectors. It is essential that every incoming trunk have access to final selectors in each of the 20 groups. Accordingly, it is necessary to have 20 groups of trunks originating on the five multiple banks of each incoming frame, which means four trunk groups to each bank. Since there are 100 sets of terminals in each bank, each group will contain 25 sets of terminals. The top set of terminals in each group is used for overflow, as in the case of the district and office frames, which leaves each group a capacity of 24 working trunks.

Since one group of trunks on each incoming frame must be reserved for each of the 20 groups of final selectors, it is impossible to build up groups of more than 24 trunks by making the overflow terminals test busy. Therefore, split groups of trunks are used to obtain the number of trunks required for each final multiple of 500 lines. For instance, if 60 trunks are needed for one set of final multiple, 24 will appear in one set of incoming multiple, 24 more in a second set of incoming multiple, and 12 more in a third.

The incidental functions of an incoming selector are to provide current for ringing the called subscriber as soon as the connection is completed and to furnish talking current to the called subscriber when he answers.

Issue
11-1-21

THE FINAL SELECTOR FRAME

T.D.M.
7.114

The final frame is, as its name implies, the last one used in establishing connection with the desired line. The selectors on a final frame are of the individual line selecting type, that is, they stop on one particular set of terminals instead of on an idle set of terminals in a particular group. Local trunks from the incoming multiples terminate, via the sequence switch and commutator, at the multiple brushes of the final selectors. Subscriber's lines are connected to the multiple banks of the final frames.

At least one final frame is used for each group of 500 subscribers. Since the capacity of a final frame is 60 selectors, there can be only 60 trunks from incoming frames to handle the traffic over a group of 500 subscribers' lines unless these lines are multiplied to additional final frames. Whenever more than 60 trunks are needed, additional frames or portions of frames are provided, and the lines extended to their multiple banks. For instance, if the traffic over a particular group of 500 lines required 120 trunks, two final frames would be provided with their multiple banks wired in parallel.

Frames for providing the additional selectors are furnished with a capacity of 60 selectors; but, if the estimated number of additional selectors required is less than 30, the multiple banks may have an insulating cut in the center, one-half being used in connection with the first frame and the other half as an addition to another frame. The multiple banks may also be cut between the 40th and 41st terminals, providing other combinations of additional selectors.

Private branch exchanges always have a number of sets of wires from the central office. These are known as P.B.X. trunks and are given consecutive numbers, so that they may appear as a unit in the final multiple. To get a P.B.X. station, it is only necessary to dial the number of the first trunk in the P.B.X. group; in fact, that is the only number given in the list of subscribers. If the first trunk in the group is busy, the final selector will proceed to hunt over all the other trunks in the same group until it finds an idle one. If all the trunks are busy, the selector will stop when it reaches the last trunk of the P.B.X. group and will then send a busy-back tone to the calling subscriber.

If an individual line is being called, the calling subscriber will at once hear a busy-back tone if the line is busy.

Issue
11-1-21

THE PANEL LINE FINDER

T.D.M.
7.116

The panel line finder, like the individual line switch, enables a group of subscribers to be served by a considerably smaller group of district selectors. Line finder frames, one of which is shown on illustration 7.1161, are of the panel type and are very similar to selector frames, except that they have 15 multiple banks instead of 5. A line finder bank consists of 20 sets of line terminals, so that the capacity of the 15 banks is 300 lines. Each terminal strip in the bank has 60 contact lugs, 30 on a side, and the line finder frame accordingly has a capacity of 60 line finders. Each line finder is linked with a district selector by means of a four-wire circuit.

A line finder bank may have an insulating cut between the 30th and 31st or between the 40th and 41st terminals. By using the different kinds of banks, a subscriber may be served by a group of 60, 40, or 28 line finders. In the first case, 300 subscribers are served by the 60 line finders on one frame; in the second case, 900 subscribers are served by the 120 line finders on two adjacent frames; and in the third case, 600 subscribers are served by 56 line finders on one frame. In case 60 line finders are not sufficient to handle the traffic over 300 lines, it is the practice to leave one or more of the banks blank instead of multiplying the lines to an additional frame.

All line finder banks have a cross-connecting cut, as described in section 7.104. Each group of 60, 40, or 28 line finders is divided into two sub-groups, "A" and "B," one on each side of the cross-connecting cut. The cross-connecting cut inverts the order of the lines in each bank, so that those which appear in the lower half of a bank in sub-group "A" are in the upper half in sub-group "B," and vice versa. This is done in order to reduce the average distance the line finders must travel.

The line finder itself is a power driven selector, which is very similar to the kind used on selector frames, except that it has 15 brushes instead of 5. The method of driving the elevator is the same; but the device used for tripping a brush is different.

On a line finder frame the trip rods are horizontal instead of vertical. Associated with each bank is a pair of trip rods, one on the front and one on the rear. The trip rods are rotated in pairs by the trip magnets. Firmly attached to each trip rod are a number of trip fingers, one for each line finder in the group on the same side of the frame. These trip fingers are small metal tongues, with a rectangular slot in each. Illustration 7.1162 shows the relation of the trip rods and trip fingers to the multiple banks and brushes.

When a subscriber takes his receiver off the hook, his line relay operates and starts a train of operations which causes the two trip magnets associated with the bank in which his line is located to operate. The trip rods rotate and cause the trip fingers to hook over the trip levers of those brushes that are in their normal position. The same train of operations that operated the trip magnets also starts one of the line finders upward. A trip finger on the rotated trip rod engages the trip lever of the corresponding brush of this line finder, tripping the brush as it starts going up. Figure 7.1163 shows how a brush is tripped.

The operation of the line relay also causes battery to be connected to the hunting terminal of the calling subscriber's line. When the tripped brush reaches this terminal, the up-drive magnet is released, stopping the brush on the terminals of the calling subscriber's line.

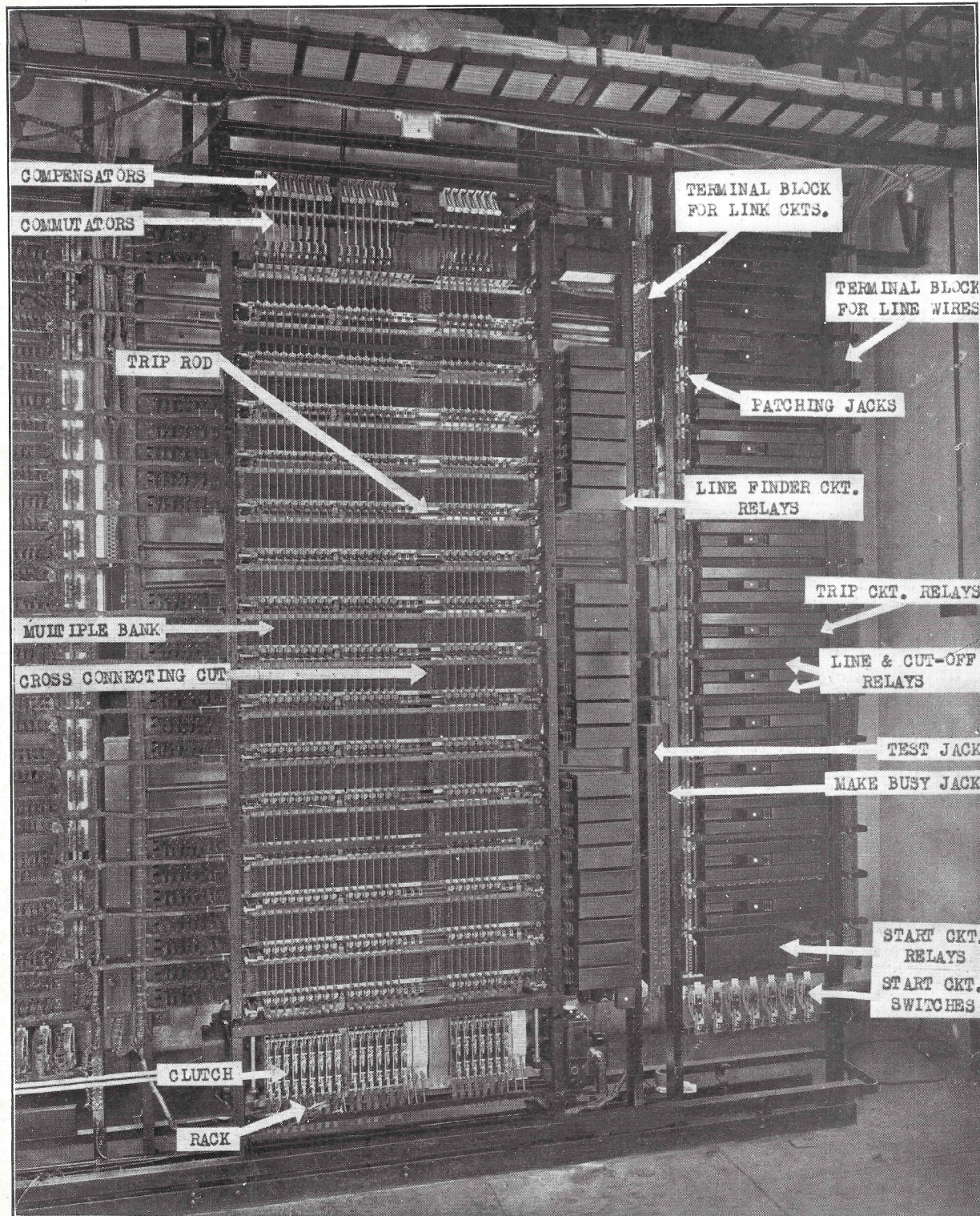


FIGURE 7.1161
The Line Finder Frame.

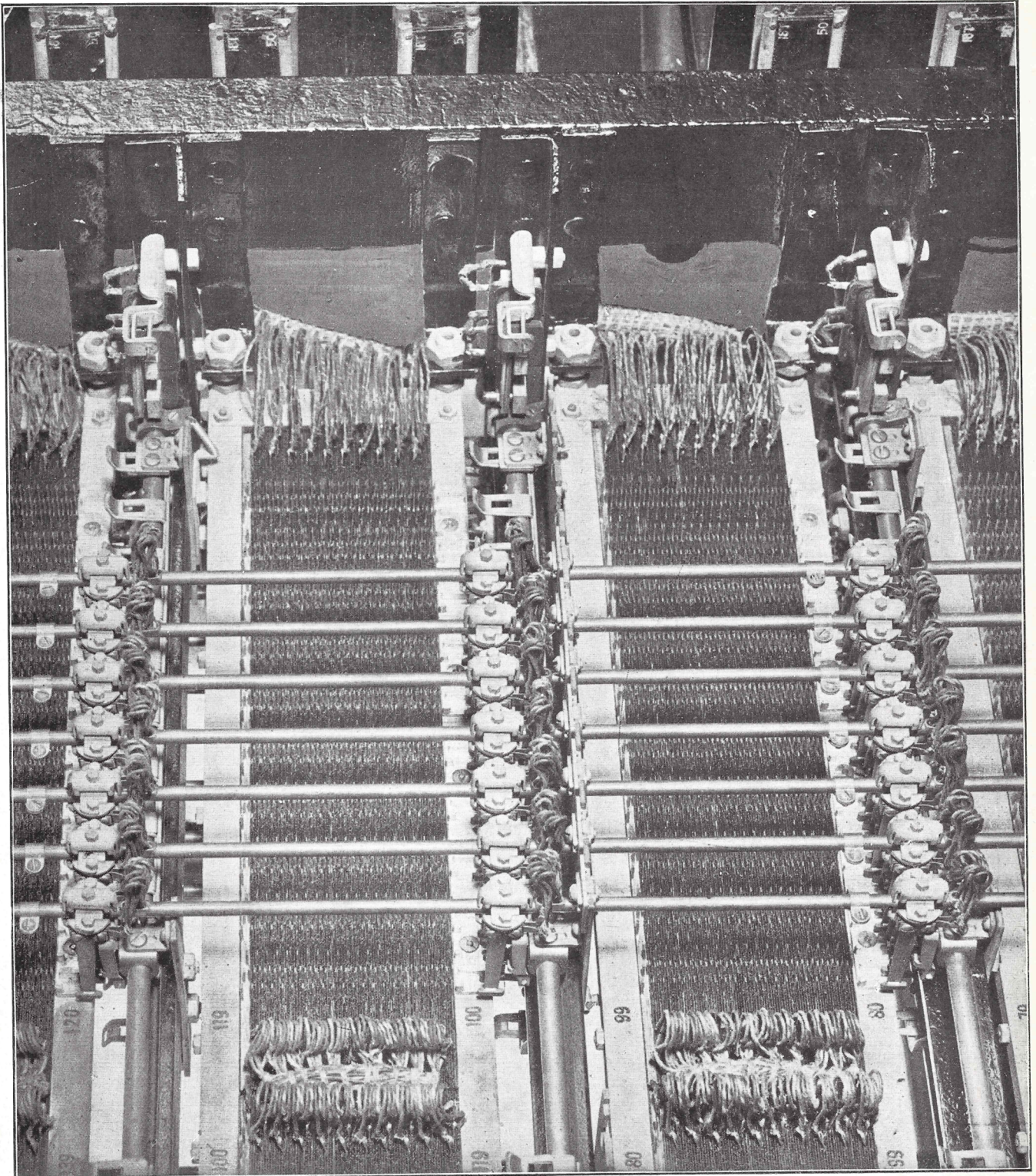
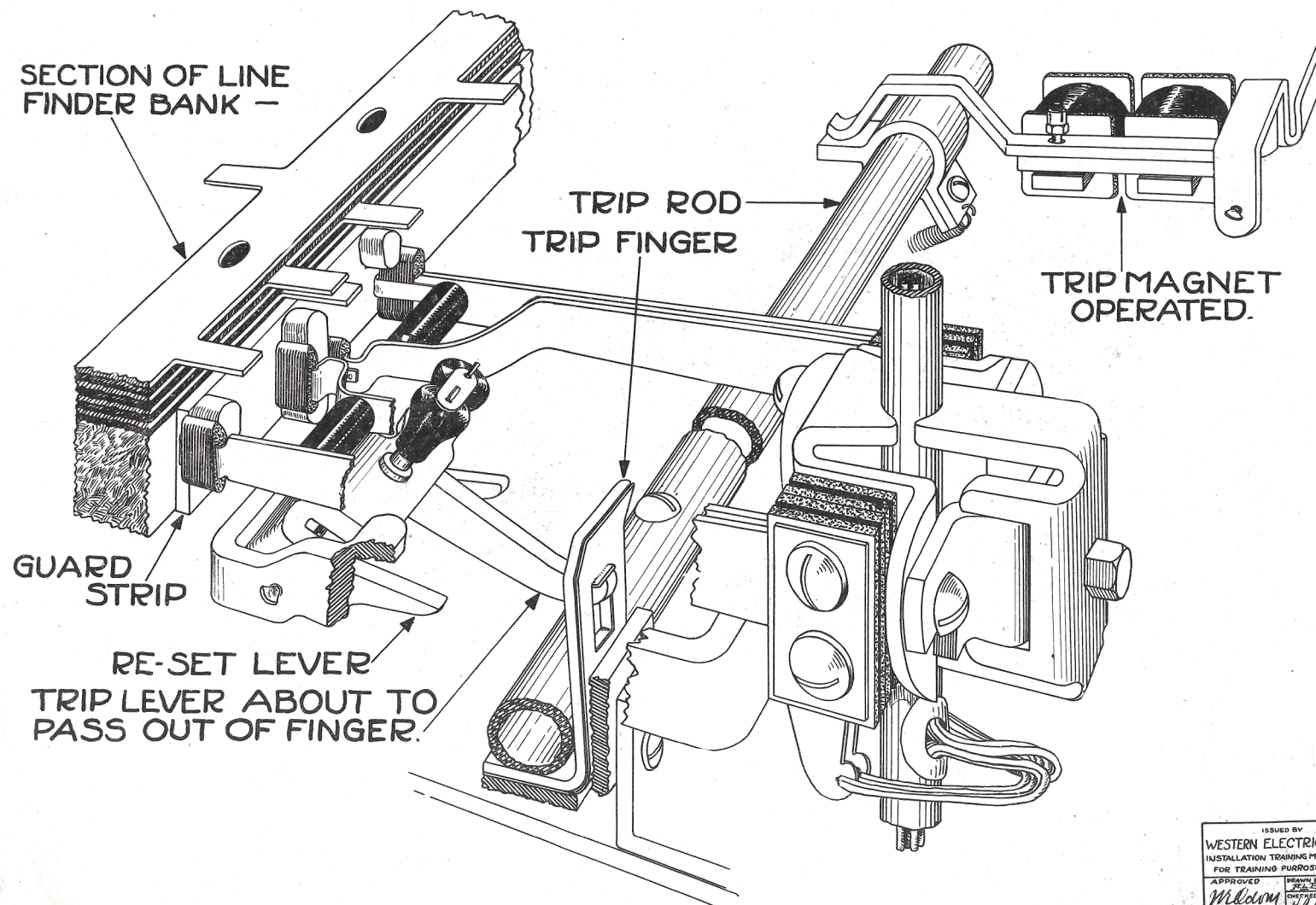


FIGURE 7.1162
Relation of trip mechanism, brush, and bank.

RELATION OF TRIP MAGNET, TRIP ROD AND MULTIPLE BRUSH TO LINE FINDER BANK.



ISSUED BY		REFERENCE
WESTERN ELECTRIC CO., Inc.		
INSTALLATION TRAINING METHODS DEPT.		
FOR TRAINING PURPOSES ONLY		
APPROVED	DRAWN BY	DATE
W. J. M.	W. J. M.	1-2-22
CHECKED BY	DATE	T.D.M.
		5335

FIGURE 7.1163

Method of tripping line finder brushes.

The line finders in each group are allotted in succession by a start circuit, the main part of which is a selector switch, shown on illustration 7.1164. A line finder in the "A" sub-group is used whenever the terminals of the calling line are located in the lower half of the "A" sub-group of the bank; and the same holds true for those in the "B" sub-group. If all the line finders in one sub-group are busy, those in the other sub-group will be used irrespective of the location of the calling line.

It is evident that, as a rule, two line finders in the same group of 60, 40, or 28 cannot start hunting for a line at the same time, since in that case two brushes on each line finder would be tripped. However, if calls are originated simultaneously by two subscribers whose lines are in different sub-groups of the same bank, two line finders will start, one in sub-group "A" and the other in sub-group "B." This is possible because only one pair of trip magnets will be operated, and because each line finder will stop when it reaches the lowest hunting terminal with battery on it.

Since every line finder is permanently linked with a district selector, only as many line finders are needed as there are district selectors in the central office. Each district selector has a sender selector associated with it; and, as soon as a line finder has started to hunt for the calling line, the associated sender selector starts hunting for an idle sender, with the result that the subscriber may begin to dial almost immediately. Figure 7.1165 shows the relations between the subscriber's line, the line finder, the district selector, and the sender.

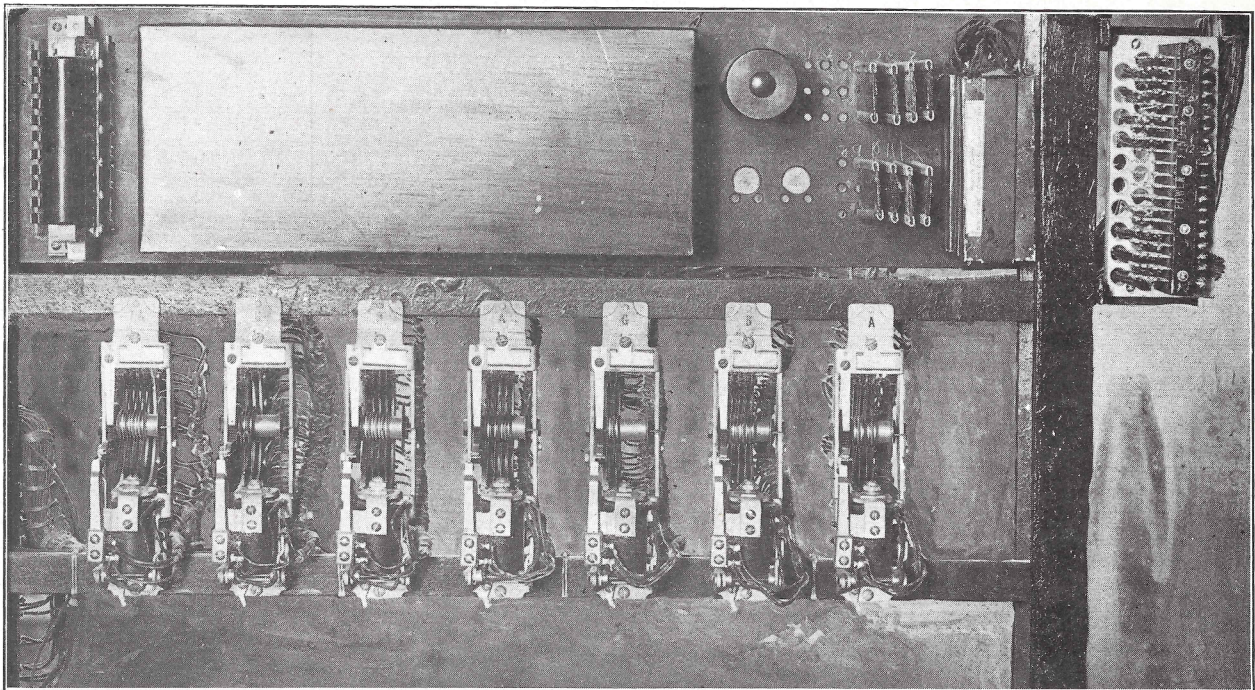


FIGURE 7.1164

Selector switches and relays of the start circuit.

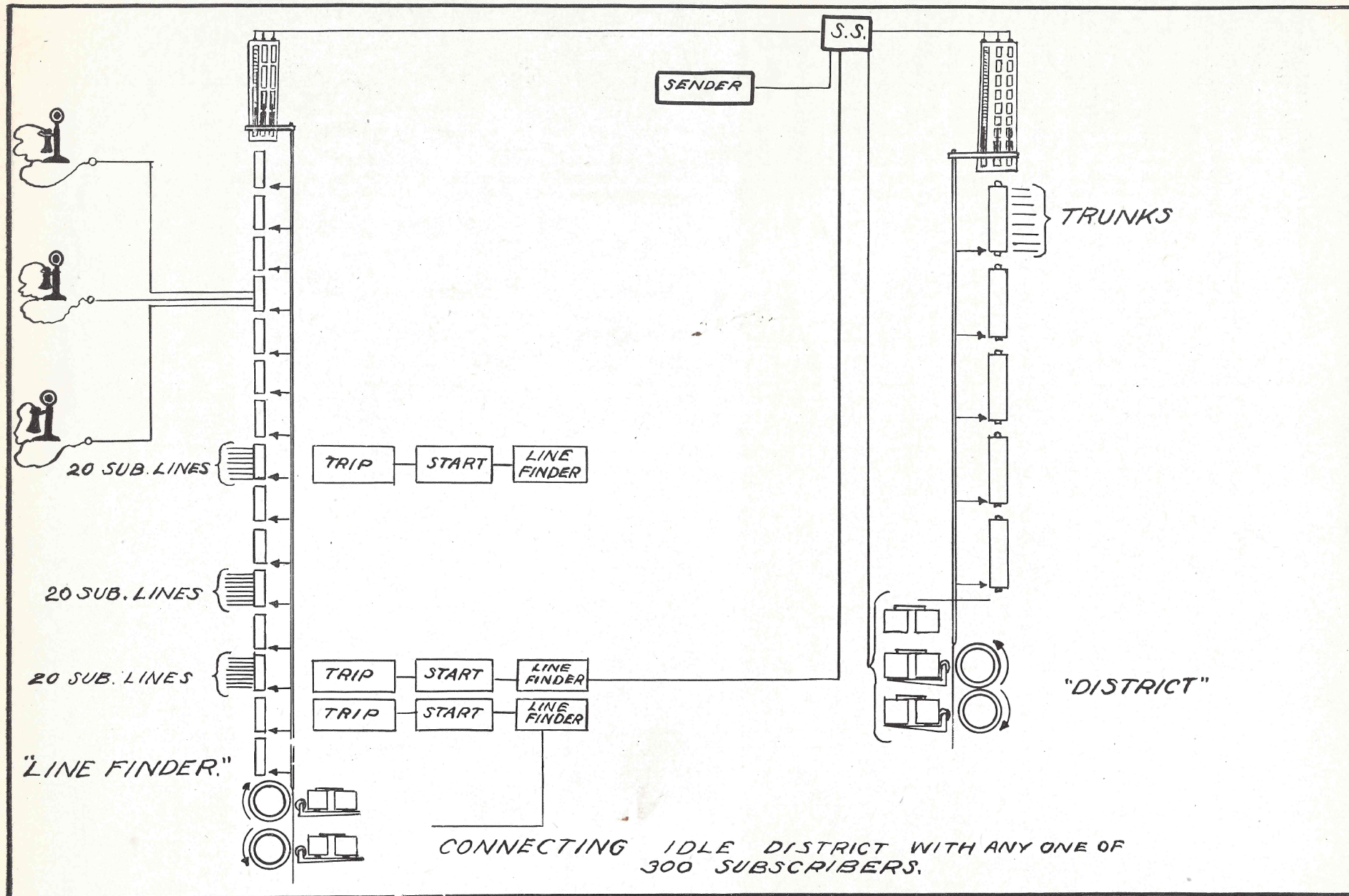


FIGURE 7.1165

Relation of subscriber, line finder, and district.

Issue
11-1-21

INTRA-OFFICE SWITCHING

T.D.M.
7.200

The problem of intra-office switching is to connect any one of the 10,000 lines terminating in a central office with any other line terminating in the same office. Figure 7.2001 shows this diagrammatically.

In a manual office, an "A" operator, by means of a double cord, connects the calling subscriber's line to a trunk outgoing to the office of the called subscriber. This trunk terminates as a single cord, known as a calling cord, at a "B" operator's position. The "B" operator has access to the multiple jacks of all the lines terminating in the office and can complete the connection with any one of these lines by inserting the plug at the end of the calling cord into the jack of the desired line. The "B" operator's job, therefore, is to complete the connection with any one of 10,000 lines.

In a machine switching office this is accomplished in five distinct steps by an incoming and a final selector. These two selectors together do the work of a "B" operator. The five steps by which any one of 10,000 lines may be picked out will now be considered briefly.

OTHER PHONE
CONNECTED TO ANY
TELEPHONE TO BE



ALPHA BOND

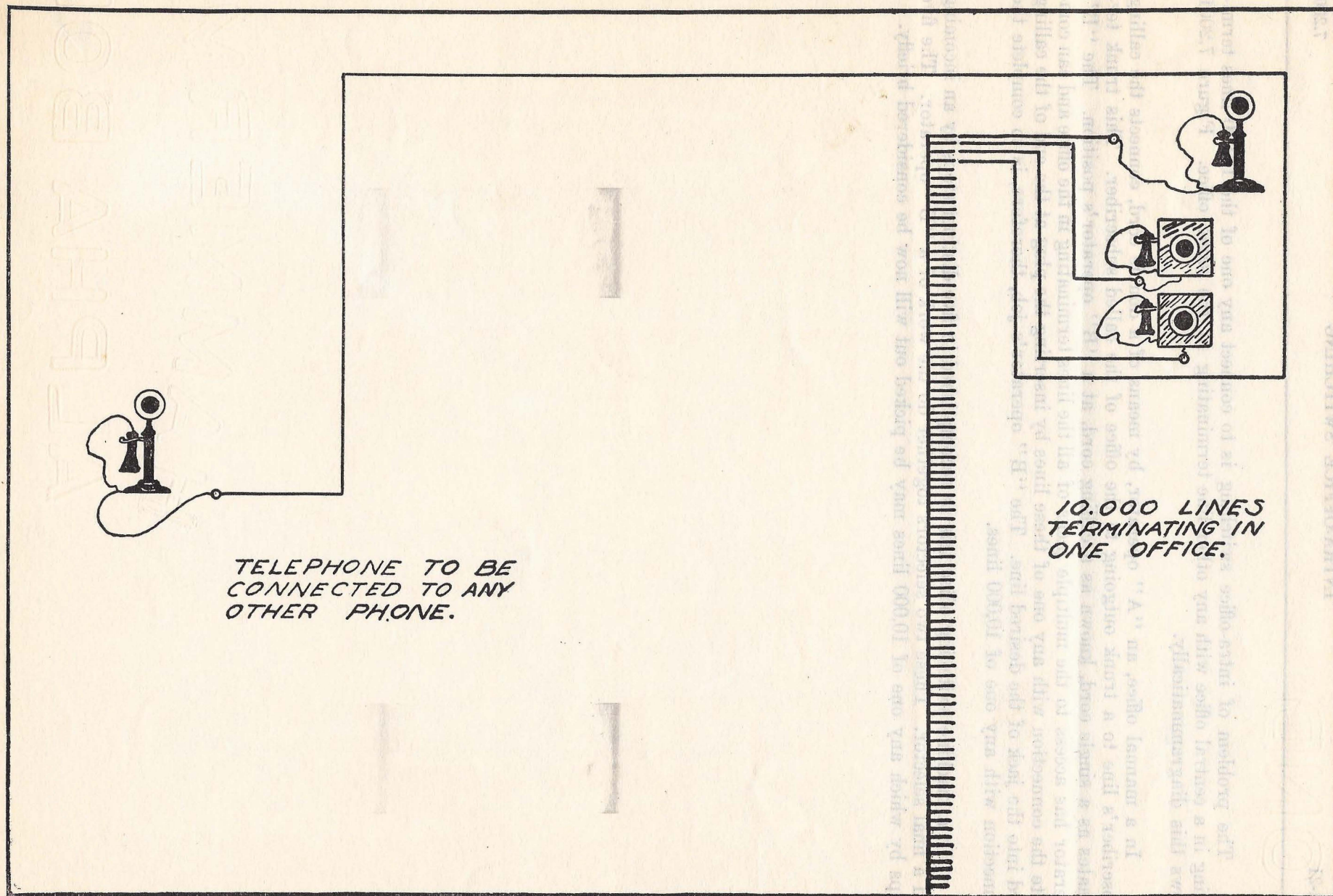


FIGURE 7.2001

Issue
11-1-21

FINAL TENS AND FINAL UNITS SELECTIONS

T.D.M.
7.201

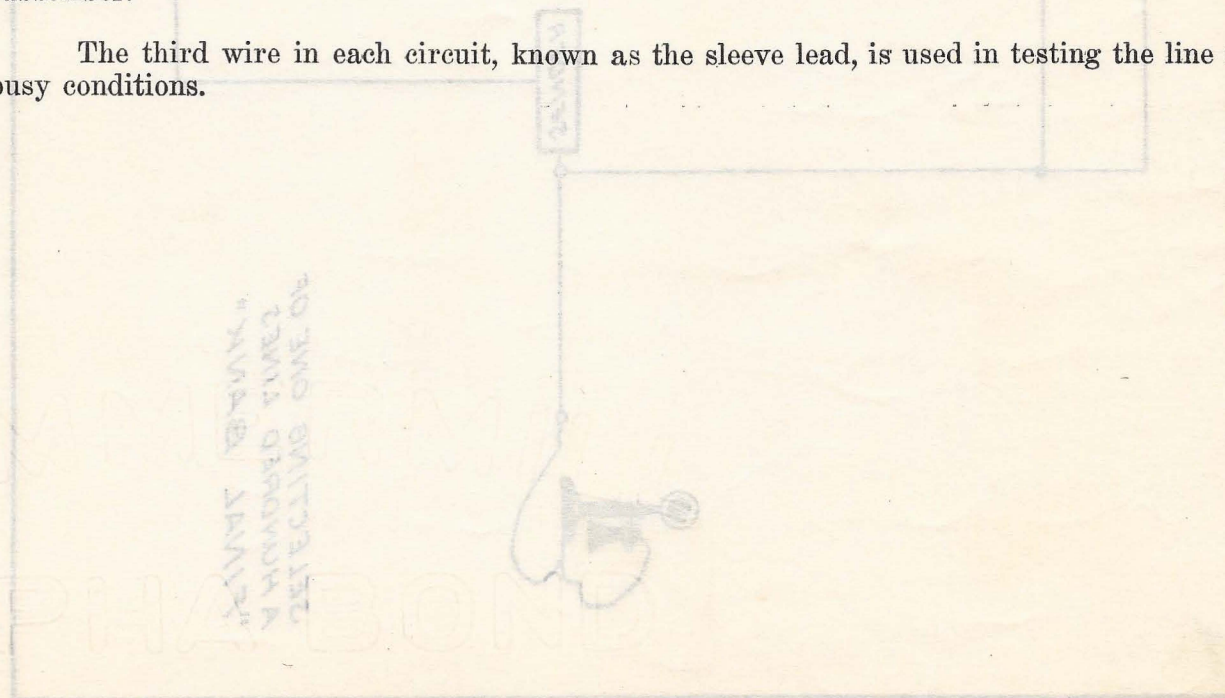
The connection of one telephone to any one of 100 telephones, which is the last part of intra-office switching, is accomplished in two steps known as final tens and final units selections. Figure 7.2011 shows these two steps diagrammatically. It is to be assumed that the calling station has been connected to a final selector and that one of the multiple brushes of that selector has been tripped. The brush is now caused to move upward over the 100 sets of terminals in the multiple bank and to stop on the right set.

For convenience in selection, the bank is arbitrarily divided into 10 groups of 10 lines each. The first step in selecting one line out of 100 is the selection of one of these groups of 10, and is therefore known as final group or final tens selection. For this selection, the high speed up-drive magnet is operated, moving the elevator upward under control of the sender, which is in turn controlled by ground pulses sent out from the "B" commutator. When sufficient pulses to satisfy the sender have been sent back, the sender causes the up-drive magnet to release, stopping the brush on the bottom set of terminals of the group in which the desired line is located.

Should the desired line be the bottom one in its group, the selection is finished as soon as the elevator stops after completing group selection. However, if the line is located elsewhere in the group, another selection is necessary. For this step, which is final units selection, the low speed up-drive magnet is operated, moving the elevator upward under control of the sender as before. During this selection, the sender is controlled by ground pulses sent out from the "U" commutator.

After the brush has stopped on the terminals of the called line, the sequence switch, which is a part of the final selector circuit, advances and closes the talking leads. The talking circuit is traced as follows: over a local trunk from the incoming multiple, through the final selector sequence switch, "T" and "R" commutator and commutator brush springs, over the leads through the hollow elevator rod to the multiple brush springs, through the multiple bank terminals with which the brush is making contact, and out over the line to the called subscriber.

The third wire in each circuit, known as the sleeve lead, is used in testing the line for busy conditions.



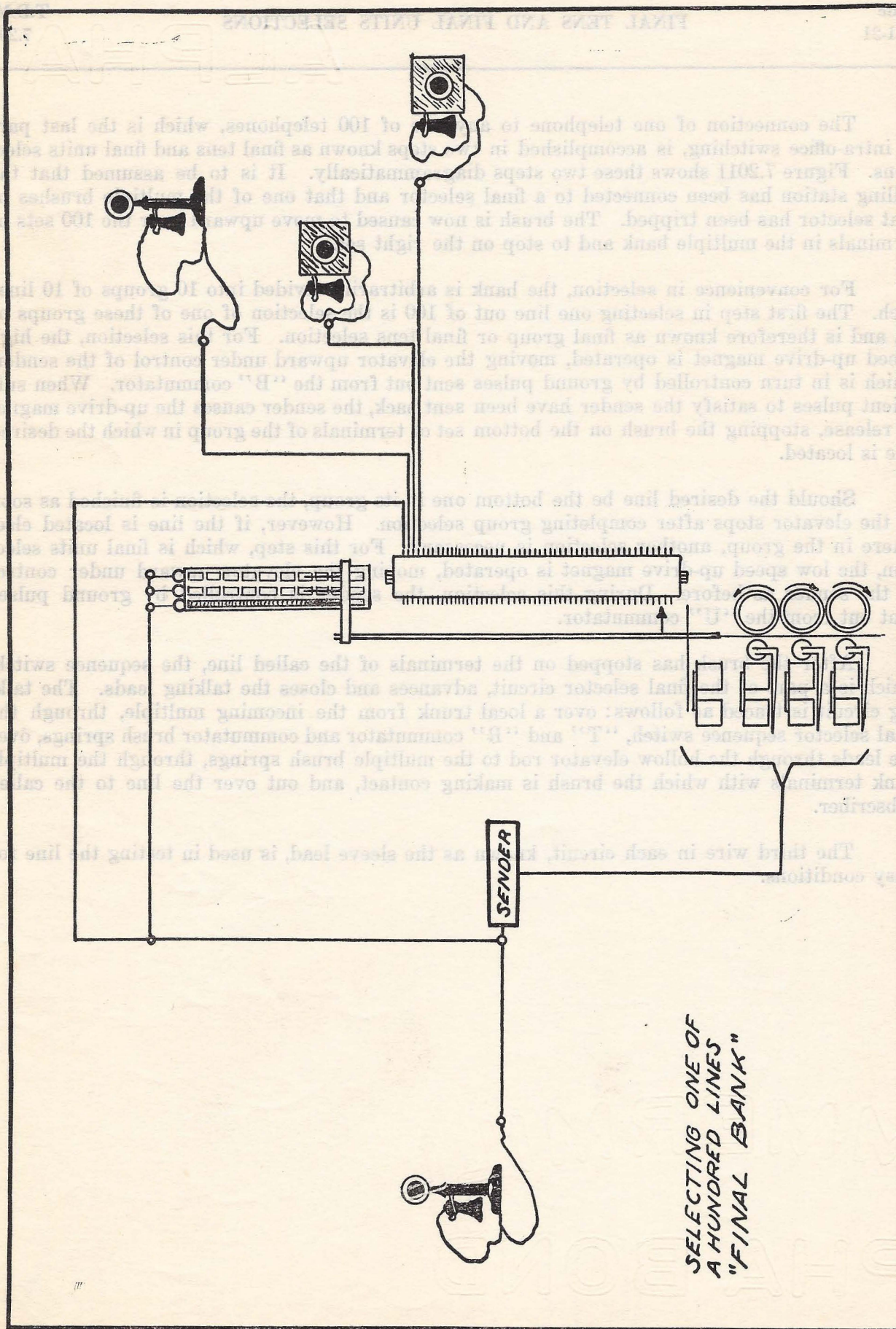


FIGURE 7.2011

Issue
11-1-21

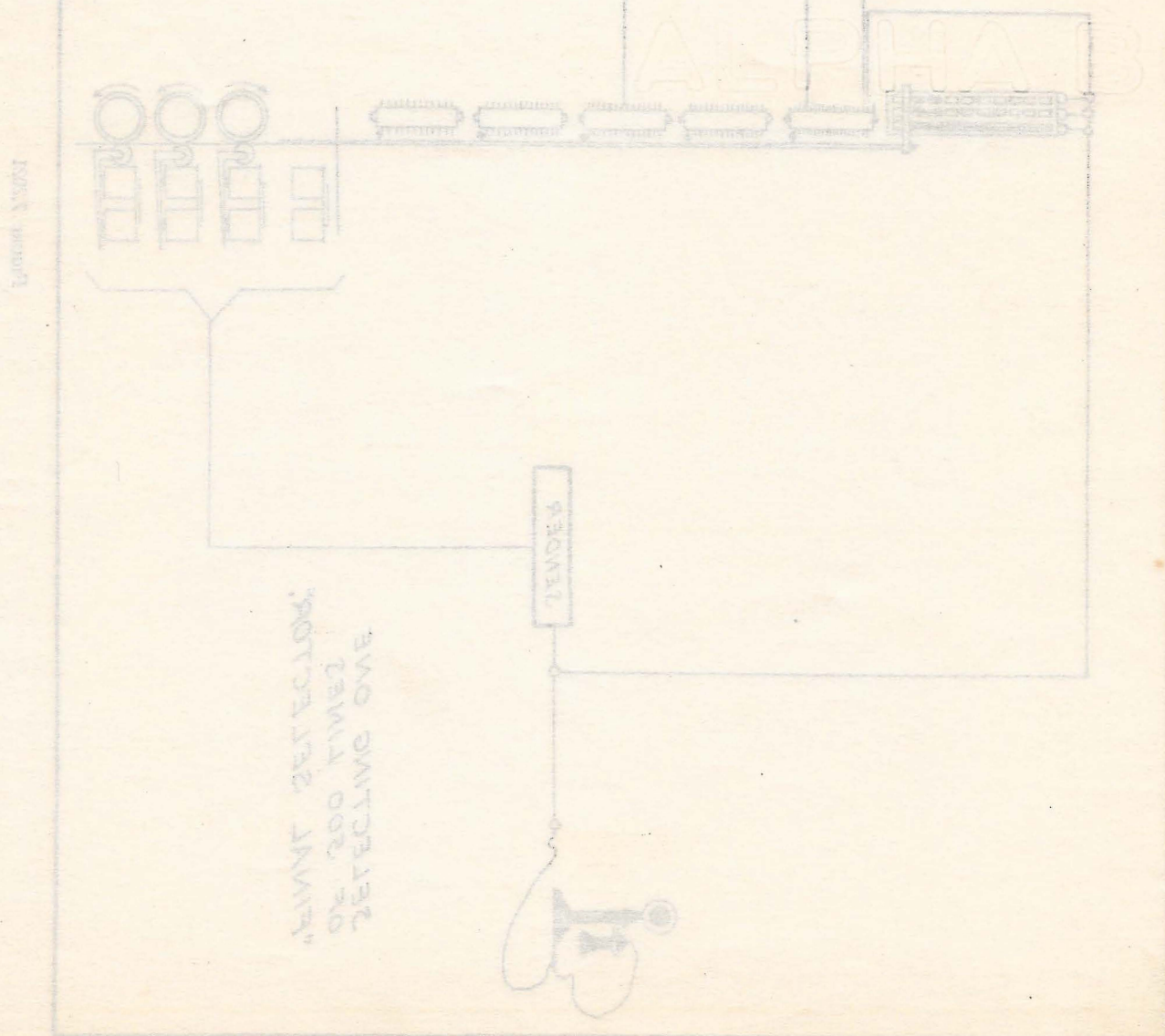
FINAL BRUSH SELECTION

T.D.M.
7.202

The preceding section considered the selection of one line from a bank of 100 lines, assuming the proper brush to have been tripped. This section deals with the selection of one line from the 500 lines terminating on the five banks of a final frame. Figure 7.2021 shows this diagrammatically.

The first step is to select the proper brush. For this purpose, the high speed up-drive magnet is energized, moving the selector upward under control of the sender, which is in turn controlled by ground pulses collected from the "A" commutator. When the sender is satisfied, it causes the up-drive magnet to release, stopping the elevator in the position such that the trip lever of the right brush is directly opposite its associated trip finger. When the elevator moves upward for group of tens selection, the brush is tripped into contact position as described in section 7.105, "Selectors."

The tripping of one of the five brushes cuts the selection down from one out of 500 to one out of 100. Final tens and final units selections are then made as described in the preceding section.



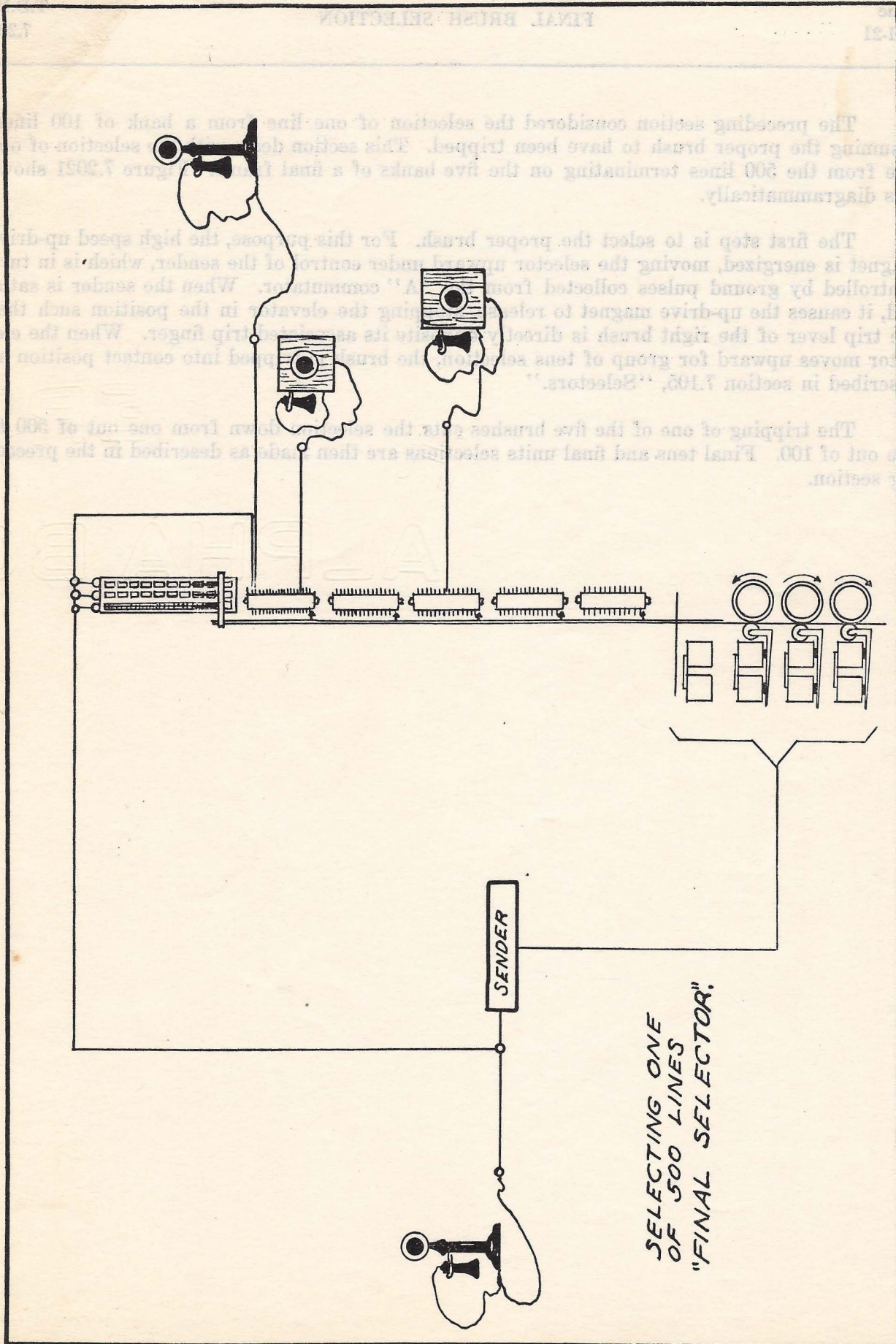


FIGURE 7.2021

Issue
11-1-21

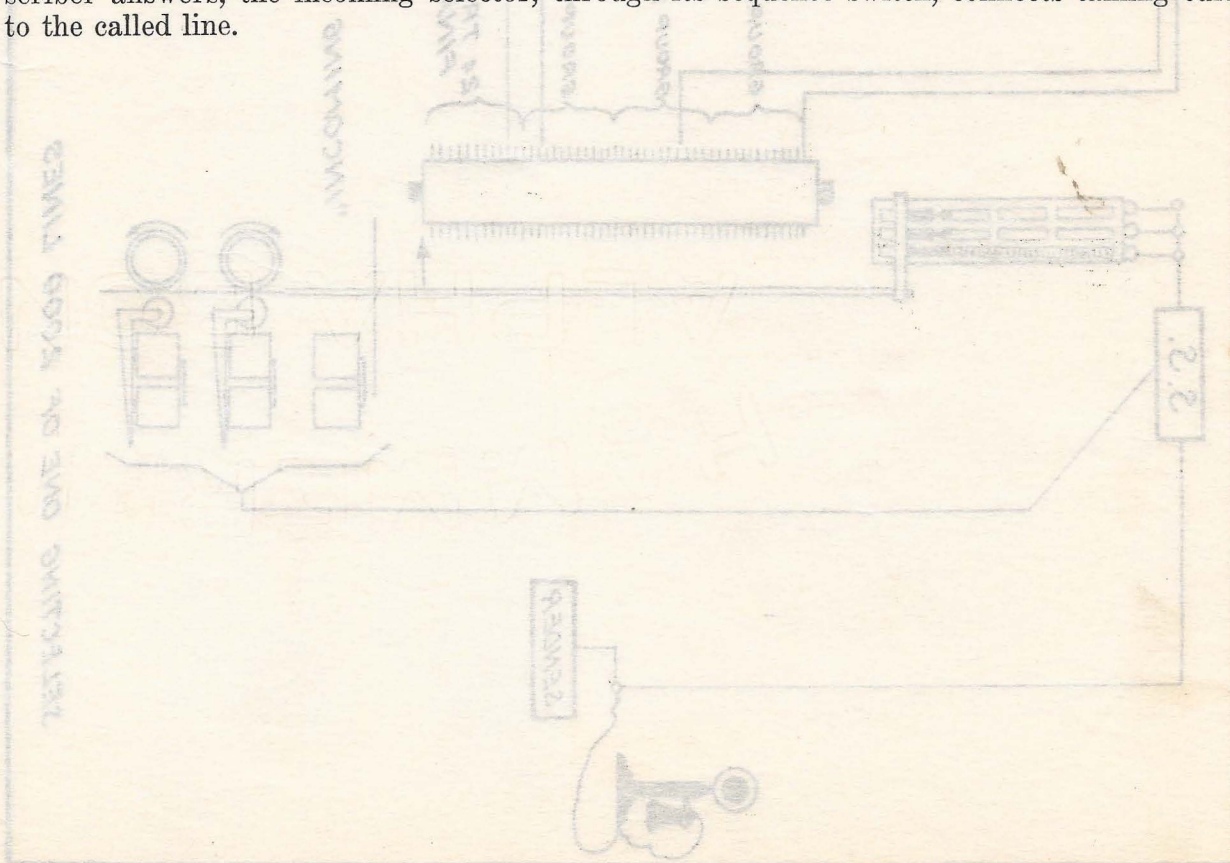
INCOMING GROUP SELECTION

T.D.M.
7.203

The preceding section discussed the selection of one of the 500 lines terminating on the multiple banks of one final frame; this section deals with the method of selecting any one of the 2,000 lines terminating on four final frames, shown schematically on figure 7.2031.

Each selector on a final frame is connected to a set of terminals in the multiple banks of incoming frames. Assuming that an incoming selector is connected to the calling line and that one of its brushes is tripped, the first step in the selection of one line out of 2,000 is to choose an idle selector on one of the four final frames. The called number determines what final frame is used. For this step, which is called incoming group selection, the elevator on the incoming frame is caused to move upward under control of the sender, the sender in turn being controlled by pulses collected from the incoming "B" commutator. When the sender is satisfied, it causes the up-drive magnet to be released, stopping the tripped brush on the terminals of the bottom trunk of the group of 24 trunks which lead to the right group of final selectors. If the first trunk in the group is idle, the connection is completed without further motion of the elevator; but if the first trunk is busy, it is necessary to hunt for an idle trunk, as described in section 7.105, "Selectors."

After the brush has stopped on the terminals of an idle trunk in the right group, the sequence switch in the incoming selector circuit advances and closes the tip and ring leads through for selection beyond. This circuit is traced over the trunk incoming from a district or office selector, through the sequence switch in the incoming selector circuit, through the commutator, commutator brush, and multiple brush to the set of multiple bank terminals with which the brush is making contact, and out over a local trunk to a final selector. The final selector now completes the selection of the desired line as described in the preceding sections, after which the incoming selector connects ringing current to the line. When the called subscriber answers, the incoming selector, through its sequence switch, connects talking current to the called line.



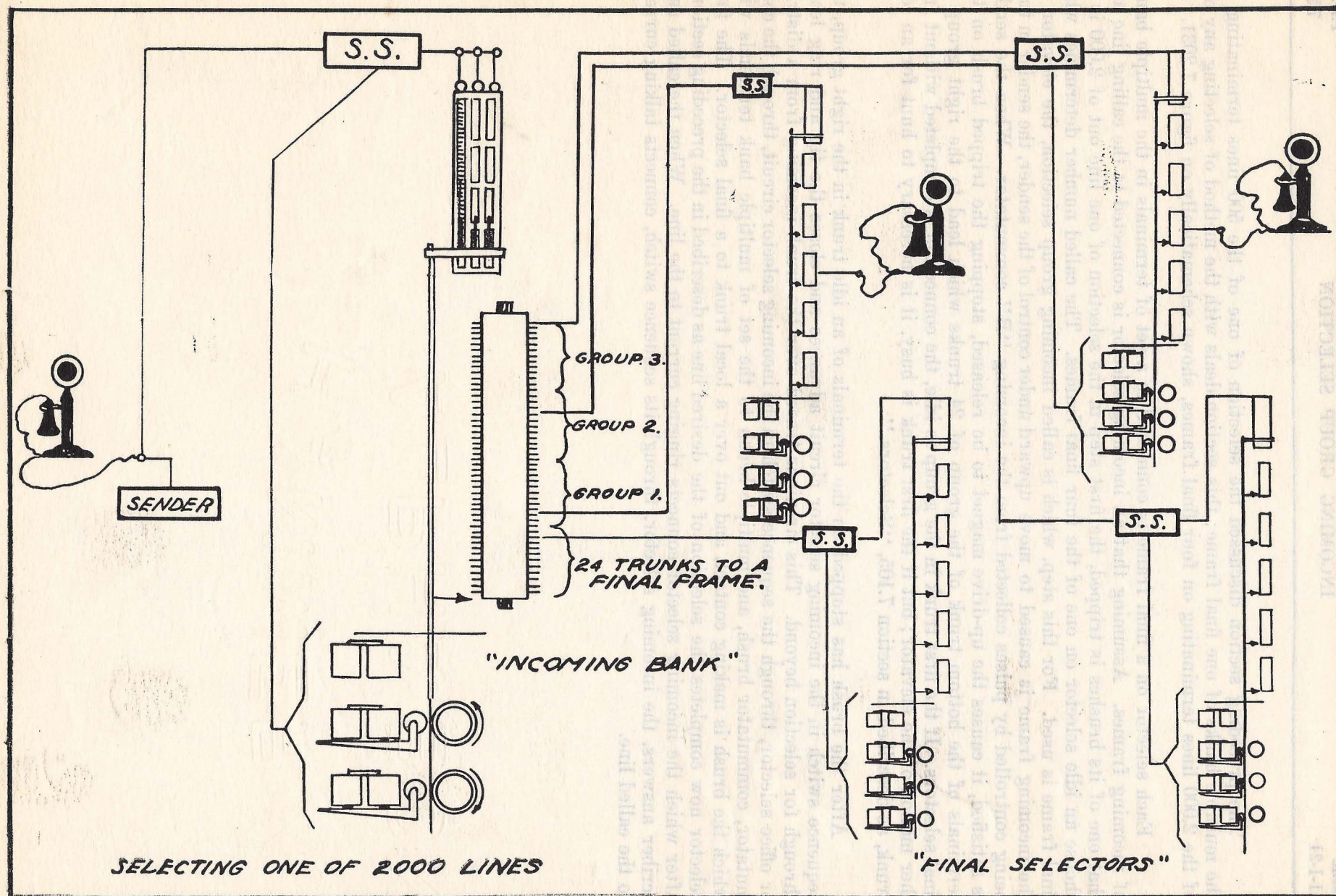


FIGURE 7.2031

Issue
11-1-21

INCOMING BRUSH SELECTION

T.D.M.
7.204

This section considers the selection of any line out of 10,000, which is the entire problem of intra-office switching. Figure 7.2041 shows 20 final frames, each serving 500 subscriber's lines, and an incoming frame connected to selectors on each of the final frames.

The first step in the selection of one line from 10,000 is incoming brush selection, which is carried out in a similar manner to final brush selection. Since there are five brushes, this step cuts the choice from one out of 10,000 down to one out of 2,000.

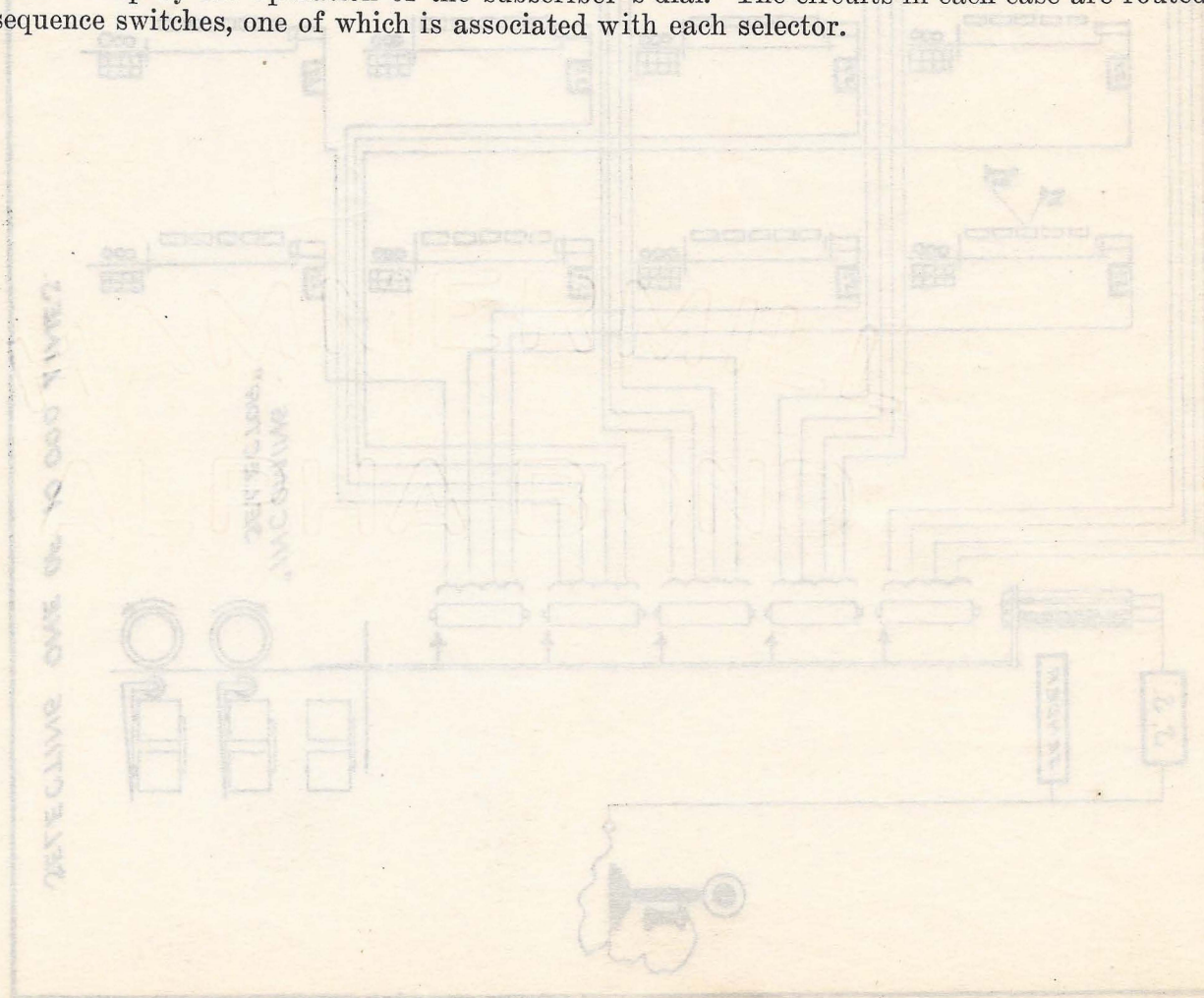
The second step, incoming group selection, cuts the choice from one out of 2,000 to one out of 500.

The third step, final brush selection, cuts the choice from one out of 500 down to one out of 100.

The fourth step, final tens selection, cuts the choice from one out of 100 to one out of 10.

The fifth step, final units selection, picks the particular line desired from the group of ten.

All these selections are under control of the sender, in which registers have previously been set up by the operation of the subscriber's dial. The circuits in each case are routed by sequence switches, one of which is associated with each selector.



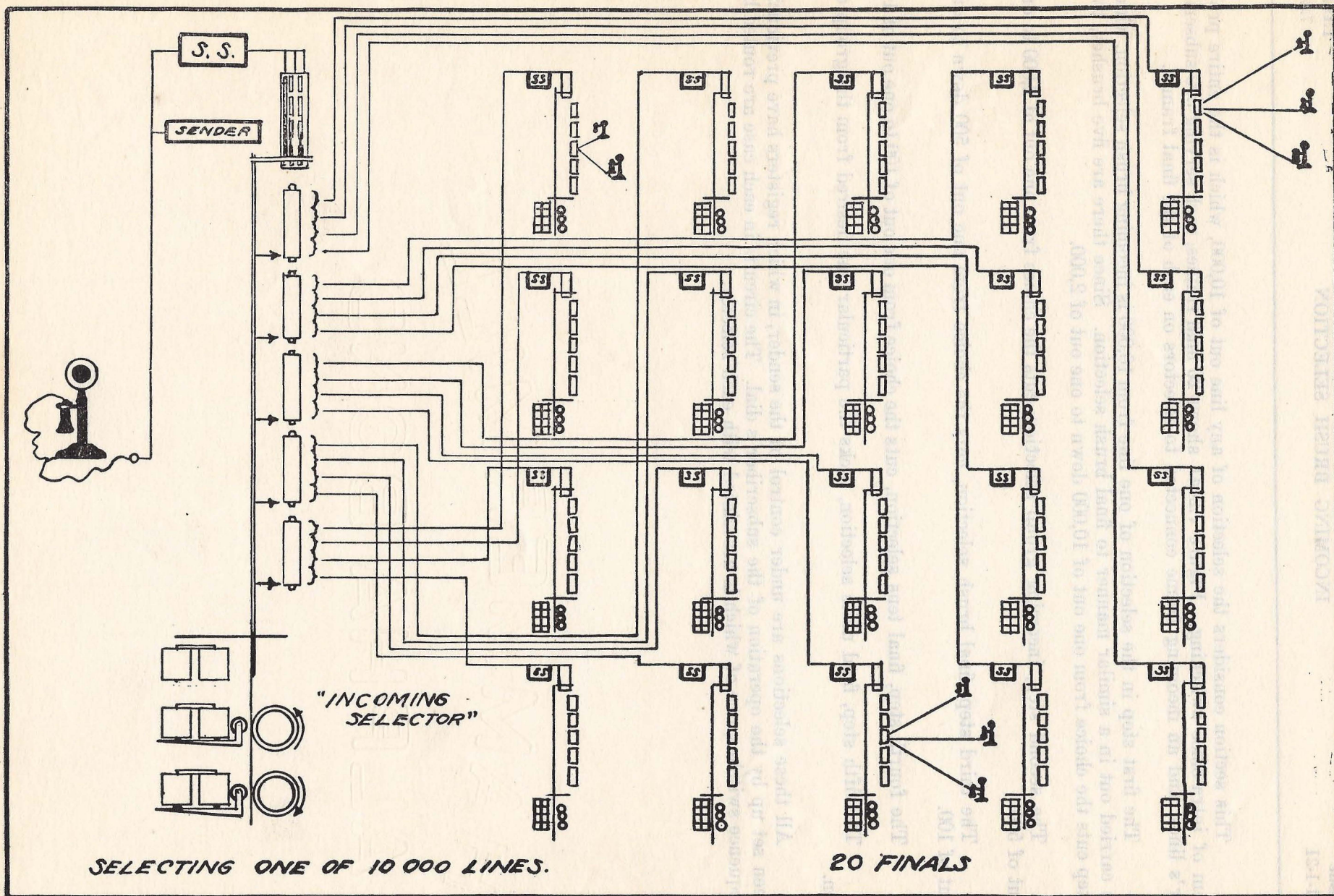


FIGURE 7.2041

Issue
11-1-21

INTER-OFFICE SWITCHING

T.D.M.
7.205

The problem of inter-office machine switching is to connect a calling subscriber to any other subscriber in the same or in a different exchange. The first operation is to connect the calling subscriber's line to an incoming selector in the office of the called subscriber. This may be done in either two or four steps, depending entirely on local traffic conditions.

In the case of the two step method, known as a skip-office call, the series of selections is as follows: District Brush, District Group, Incoming Brush, Incoming Group, Final Brush, Final Tens, and Final Units. In the case of the four step method, in which the call is routed through an office frame, the series of selections is as follows: District Brush, District Group, Office Brush, Office Group, Incoming Brush, Incoming Group, Final Brush, Final Tens, and Final Units.

District and Office frames are equipped with five multiple banks. Since each multiple bank on an office frame may be divided into as many as 9 groups, it follows that each office frame may have access to 45 central offices (groups of incoming selectors), containing 450,000 stations. Similarly, the district frame banks may be divided up into 9 groups of trunks, and each district selector may therefore have access to a maximum of 45 groups of office selectors and, through them, to 2,025 central offices containing 20,250,000 stations.

The manner in which each selection cuts down the number of stations from which to choose may be outlined as follows:

- (1) District Brush Selection cuts the number down from 20,250,000 to 4,050,000.
- (2) District Group Selection cuts it down from 4,050,000 to 450,000.
- (3) Office Brush Selection cuts it down from 450,000 to 90,000.
- (4) Office Group Selection cuts it down from 90,000 to 10,000.
- (5) Incoming Brush Selection cuts it down from 10,000 to 2,000.
- (6) Incoming Group Selection cuts it down from 2,000 to 500.
- (7) Final Brush Selection cuts it down from 500 to 100.
- (8) Final Tens Selection cuts it down from 100 to 10.
- (9) Final Units Selection cuts it down from 10 to 1.

It must be understood that this is a purely theoretical case, although it is useful in illustrating the possibilities of the panel type machine switching system. In practice, this maximum case will never be approached, since it is necessary to have more than 10 trunks in a majority of the groups, and also because the number of telephones in any local zone will never reach any such figure as 20 million.

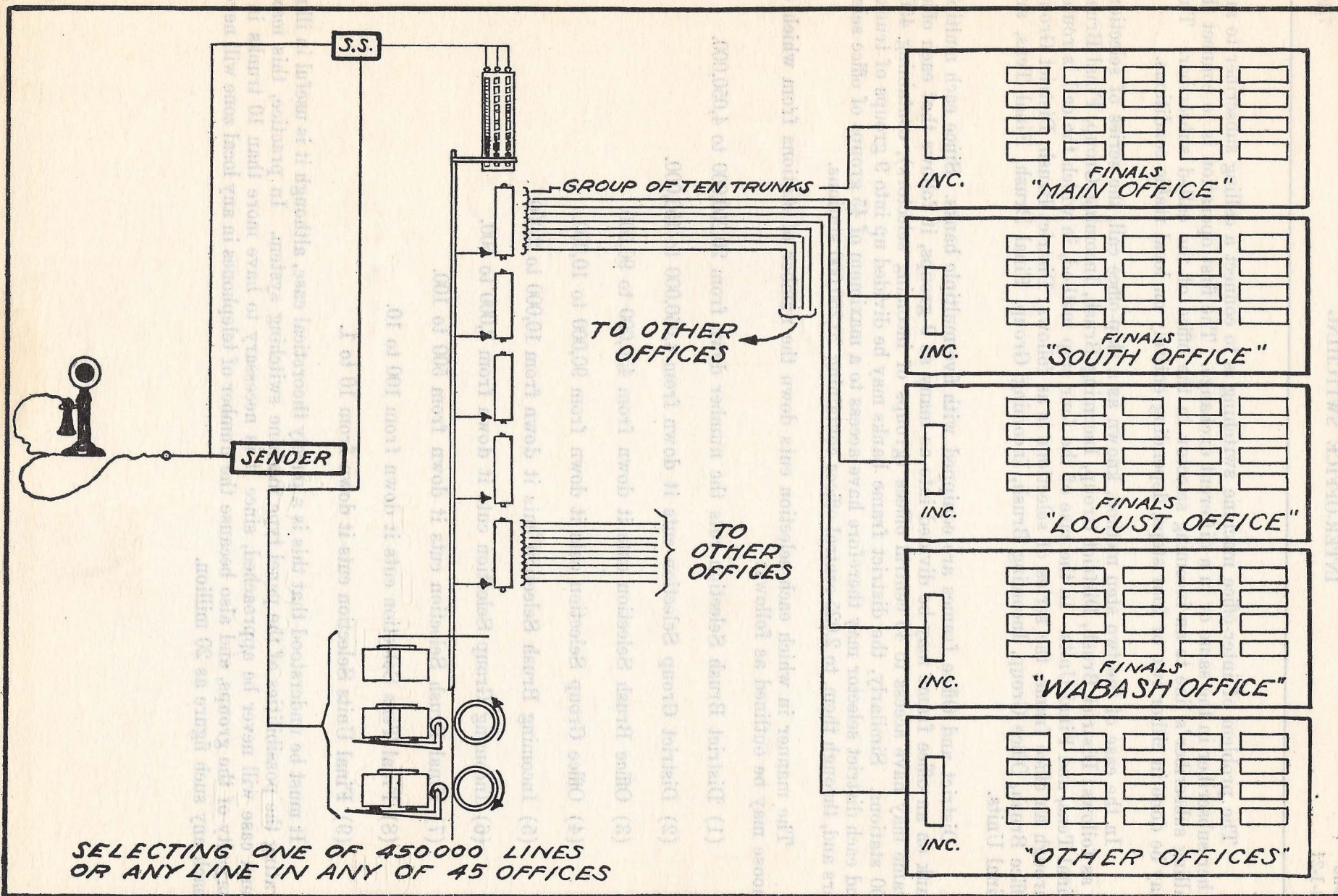


FIGURE 7.2051

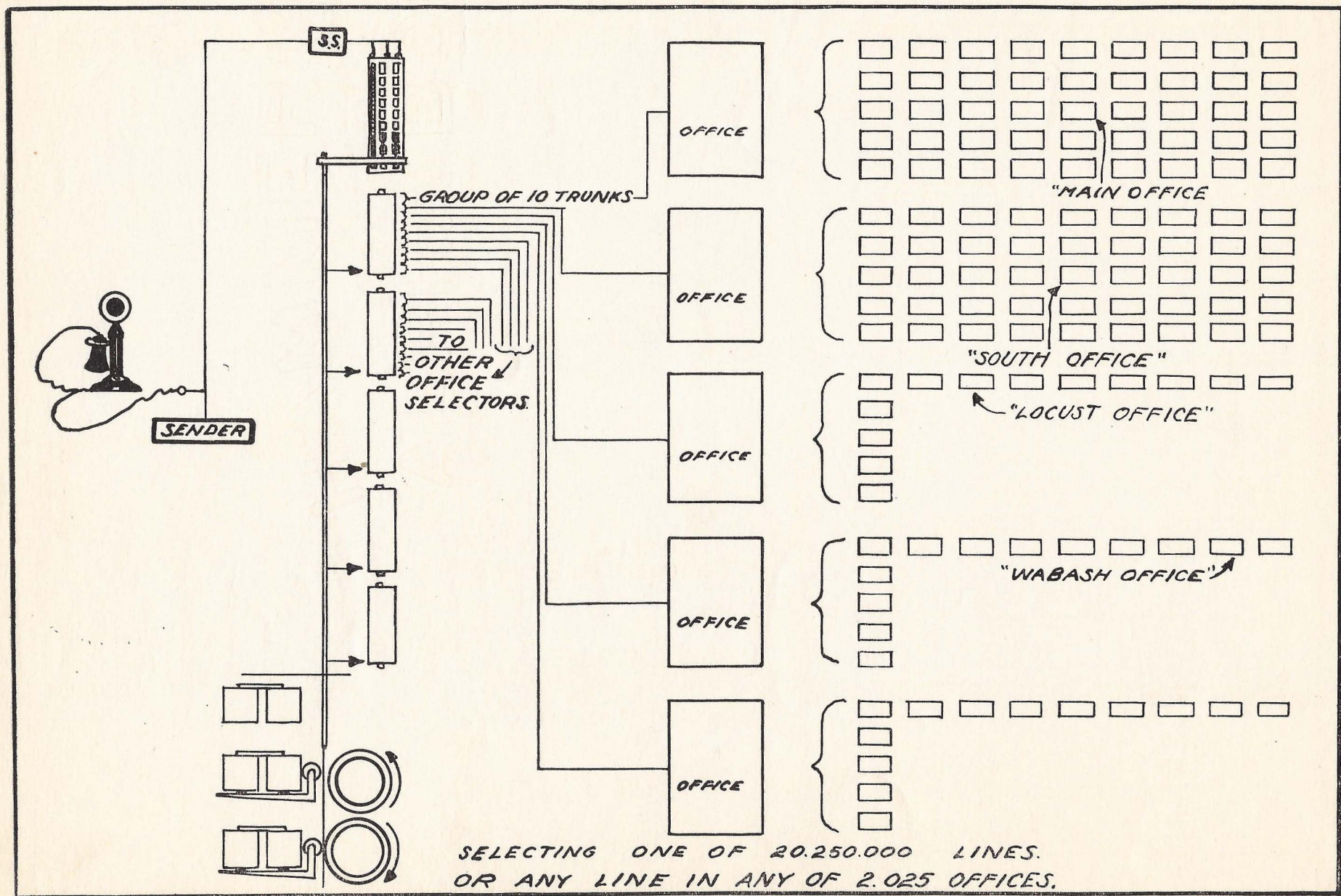


FIGURE 7.2052

Issue
5-1-21

LAYOUT OF APPARATUS

T.D.M.
7.4051

Figure 7.406 shows layout and apparatus used in a machine switching office and gives an idea of the amount of equipment involved. Shown in this sketch are 21 line finder frames. Each line finder frame is connected to 300 or 600 individual lines. Each line finder frame has sixty line finders, so that each group of three hundred individual lines may have associated with it 28, 40 or 60 line finders. Each line finder is associated with a district selector. Each district selector is associated with a sender selector.

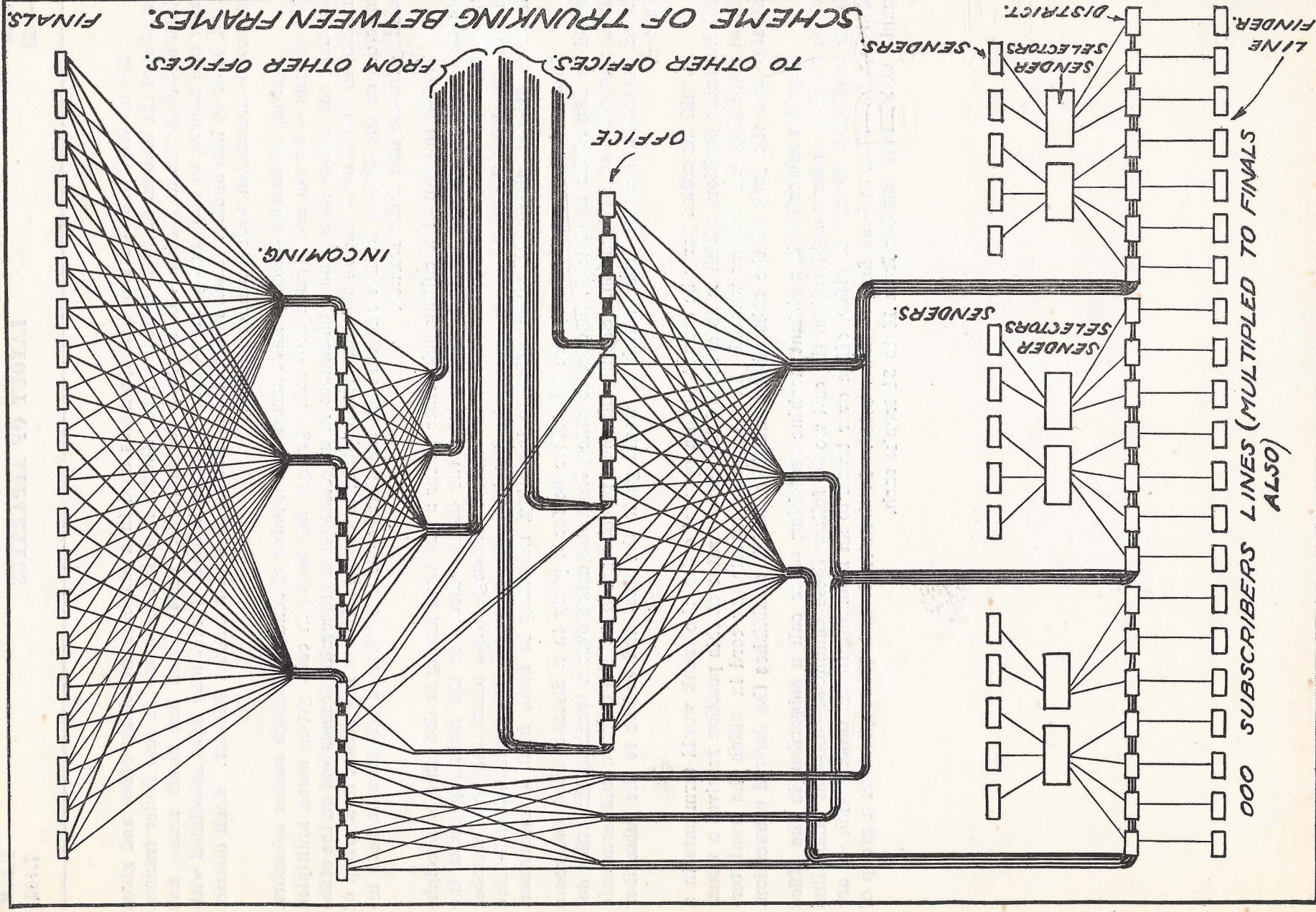
A group of district selectors have access to a number of senders through sender selectors. The district selectors are divided into three groups, the banks in each group being multiplied together, the trunks from which terminate in selectors on the incoming frames and on the office frames, so that each of the 10,000 lines terminating in the line finders has access to a group of selectors on the district frames and through the districts to a number of selectors on both incoming frames and office frames.

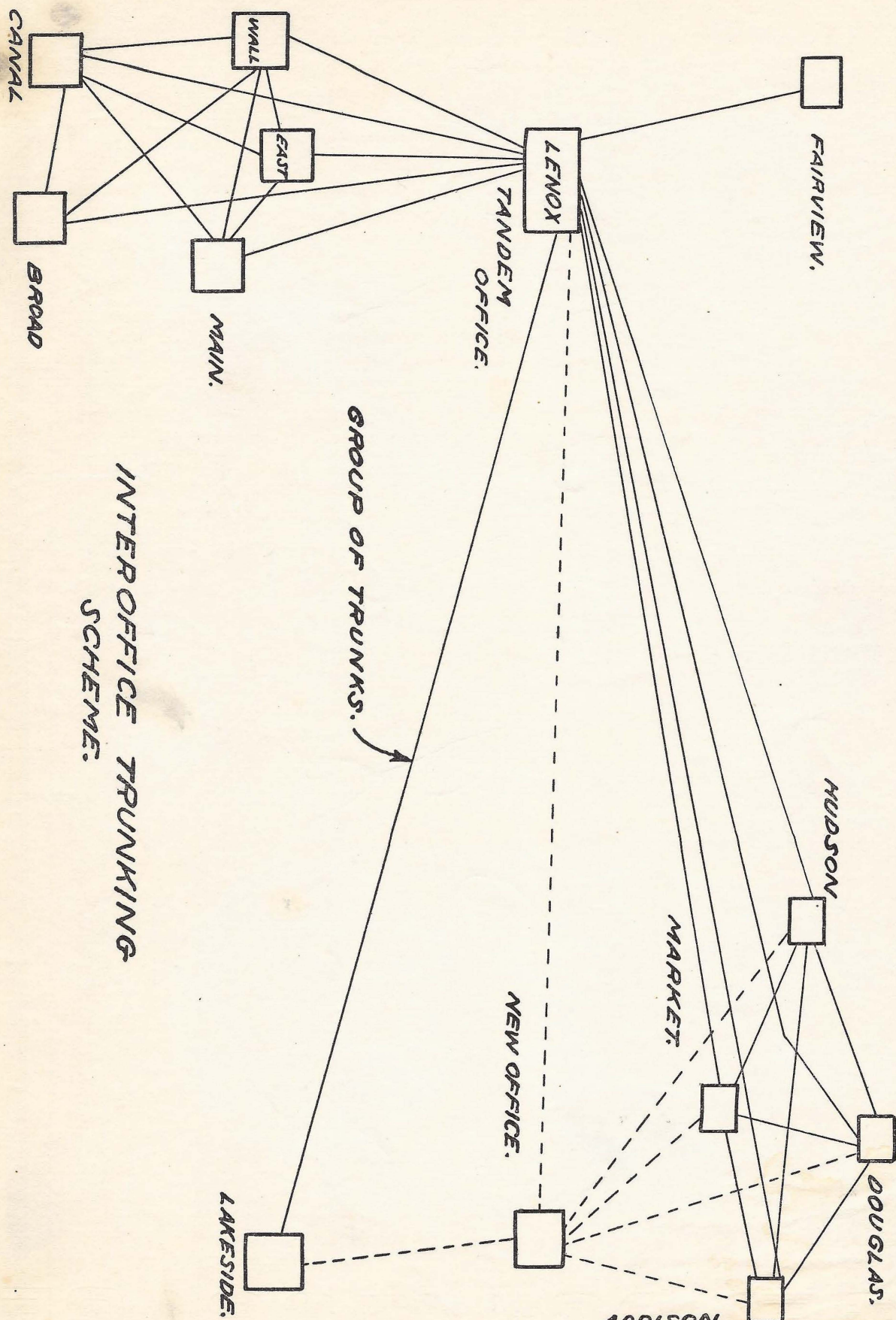
Should the call of a calling subscriber be for a line terminating in the same or a neighboring exchange, the call would be routed from the district direct to the incoming, from the incoming to the final, thence to the subscriber wanted. In large cities where the large number of offices prohibit the direct trunking from the district to the incoming, the route would be line finder to district, district to office, office to incoming, incoming to final, final to subscriber.

Should the call originated by the subscriber be for a party in a distant office, the route would be line finder to district, district to office, from the office over a trunk to the office desired, regardless of its location. Should this be a mechanical office, the trunk would terminate on an incoming selector from which it would go to the final and thence to the subscriber wanted.

Should the called party be connected to a manual office, the trunk would terminate in a call indicator position, which is so arranged that an operator at this position receives a visual signal displaying the number wanted. This operator inserts the cord in which the trunk terminates into the jack of the subscriber's multiple, which establishes the desired connection.

Should a subscriber in a distant machine switching office call a subscriber in the office which we have under consideration, the call would follow these channels:—Distant office line finder to district, district to office, office over trunk to an incoming in the office which we are studying, incoming to final, final to line wanted. In the sketch each line represents a group of trunks which may number from 10 to 91 trunks each.





T.D.M. 7409

ISSUE 2-1-21

ADDISON.

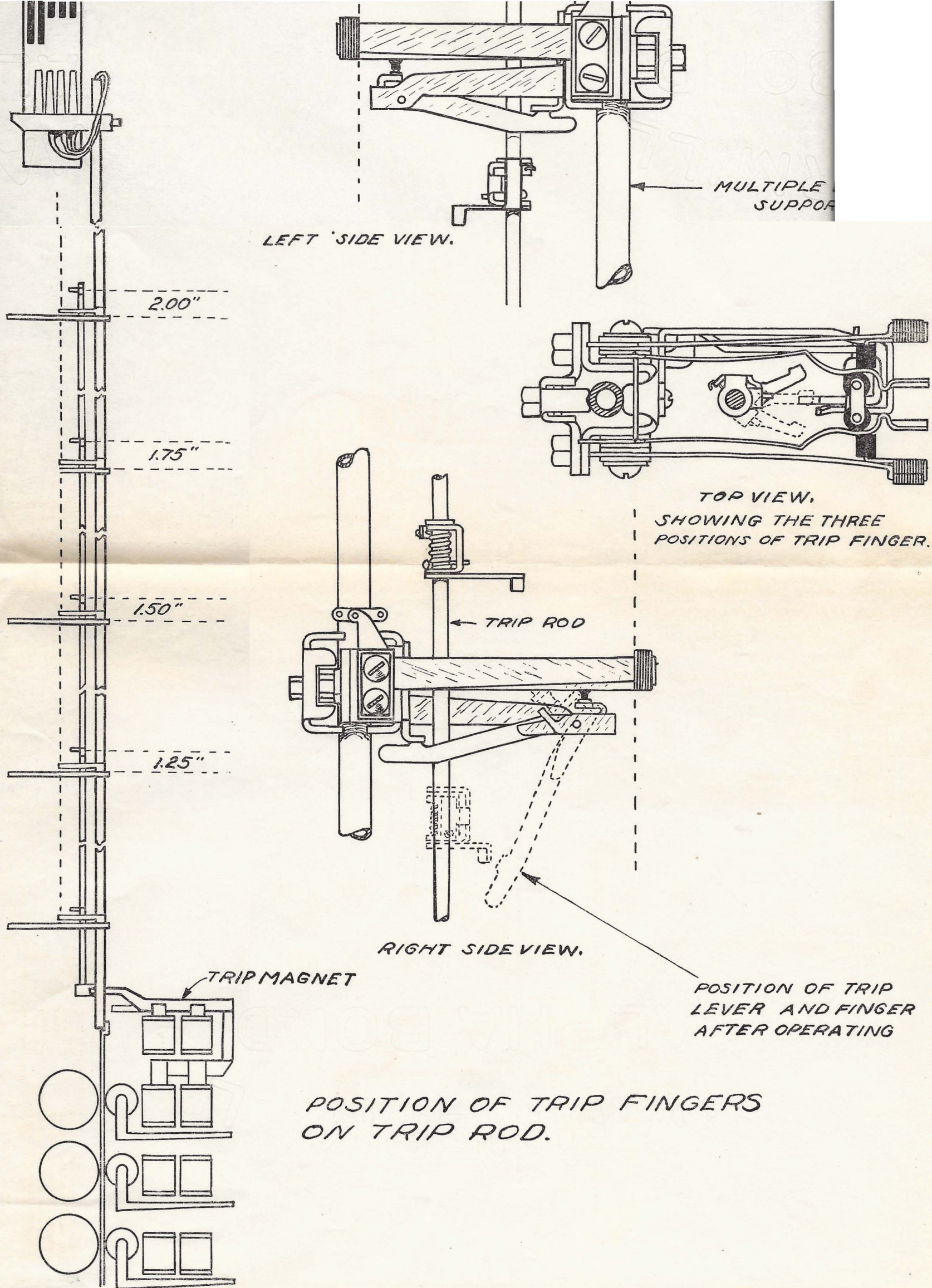


FIGURE 7.1052